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	PAGE
Supply and Training of Food Technologists	429
Hydrogen and the Periodic Table, *by L. Davies*	430
Smithson Tennant, 1761–1815, *by K. R. Webb*	432
Book Reviews	435
Institute Affairs	442
The Secretary and Registrar	442
Nomination of General Members of Council	442
Examinations	442
Personal Notes	445
Section Activities	447
News and Notes	463
Management of Research	464
Correspondence	465
Obituary	466
The Register	467
Local Sections Diary	468
Index	469

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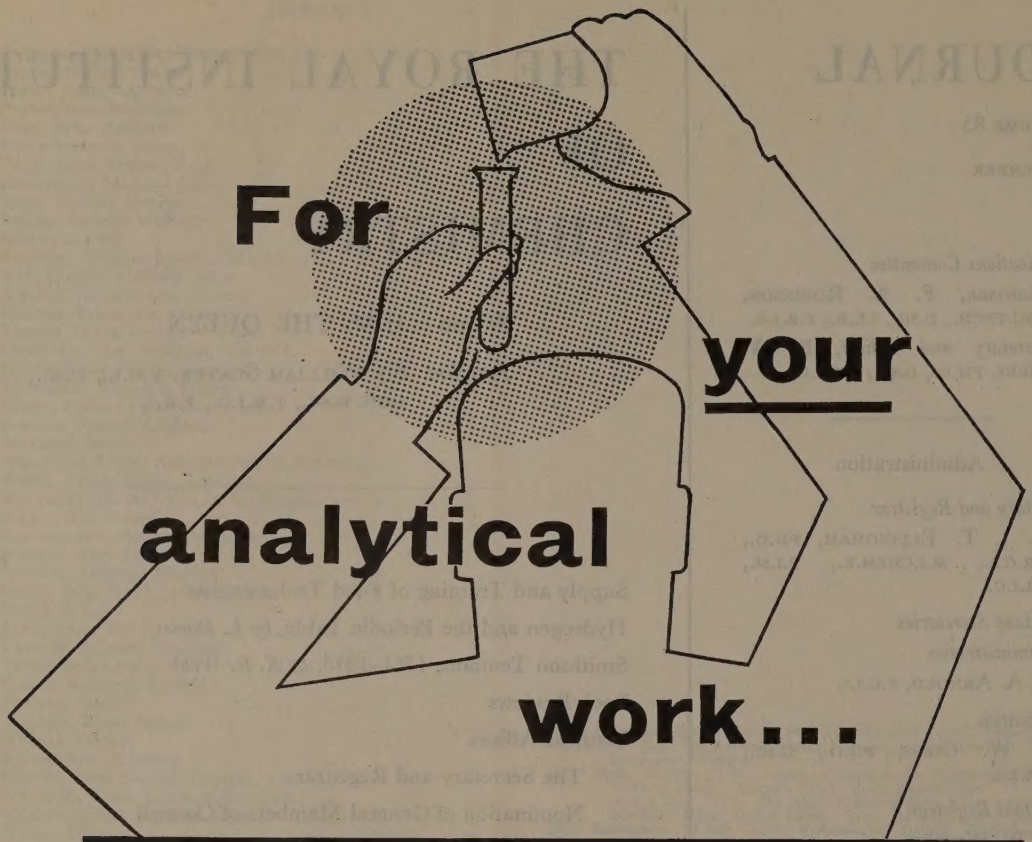

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SUPPLY AND TRAINING OF FOOD TECHNOLOGISTS

During the 1961 meeting of the British Association the supply and training of food technologists in the U.K. was discussed at a Symposium held under the auspices of Section B (Chemistry), with Professor J. C. Earl as Chairman. The subject was particularly appropriate, not only on account of requirements in the U.K. itself, but also, and probably more important, owing to the desirability of extending substantial training facilities to nationals of the under-developed countries. The overseas aspect was specially emphasized. The fact that developments in food sciences have outstripped their industrial applications is nowhere more evident than in the under-developed countries. During the next decade, in those countries, priority must be given to the application of knowledge of food and its processing gained in more developed countries. It is for this reason that the training of food technologists at a greater rate becomes a matter of urgency.

The meeting was opened by Sir Herbert Broadley, K.B.E., Director in the United Kingdom of UNICEF and formerly Deputy Director General of F.A.O., Rome, who stressed the three principal methods by which the U.K. could help the less developed countries: by sending experienced people to advise and assist, and to train assistants; secondly, by selecting promising individuals from those countries and sending them to be trained in the more highly developed and industrialized countries; and thirdly, by organizing local schemes of training under conditions similar to those in which they have undertaken their duties. Unfortunately it has not been easy, on the one hand, to find experienced men in this country who are willing to serve abroad, and, on the other, to place oversea candidates in sufficient numbers for training in food technology in this country.

Sir Herbert Broadley's introduction was followed by contributions by Dr J. D. Mounfield, Principal of the National College of Food Technology, and Professor J. Hawthorn, Head of the Department of Food Science, Royal College of Science and Technology, Glasgow. Dr Mounfield explained the different functions of the food scientist and the food technologist. The food scientist is relied upon to discover new sources of food and new and better methods of storage and processing. The food technologist is complementary, in that he applies scientific knowledge to industrial preservation processes, packing and transport. A food technologist must be a food scientist, but he must be something more. After referring to the necessity for training in the basic sciences (chemistry, physics, mathematics and biology) and the applied sciences, he referred to the desirability of some knowledge of the engineering principles associated with food processing. At present graduates tend to drift into the industry and to learn food technology by hard experience. This method can well result in superficiality of knowledge. Dr Mounfield referred to the width of interest of food scientists and technologists; in order to avoid superficiality in their training, it was wise to make them as selective as possible without sacrificing knowledge of basal principles.

Professor Hawthorn agreed very largely with Dr Mounfield on the type of training. He had made a survey of opportunities for graduates in food science, and he came to the conclusion that, in the U.K. alone, between 150 and 250 new graduates were needed for technical posts in industry, quite apart from the substantial demand from overseas territories for the training of their nationals in this country. Not only are there established postgraduate degree courses at the Royal College of Science and Technology, Glasgow, and diploma courses at the National College of Food Technology at Weybridge, but some other universities —notably Nottingham, Reading and Leeds—are introducing food science courses. He estimated that, even with these facilities, it is unlikely that we shall train more than 150 food technologists a year by 1970.

Dr J. W. Corran, Chief Chemist, J. & J. Colman Ltd, led the discussion, emphasizing one or two of the important points made by previous speakers, and pointing out that the training of students from under-developed countries was not confined to Great Britain and the Commonwealth. The U.S.A., for example, received large numbers, and they had greater training facilities. It is desirable, from all points of view, that we should receive and welcome oversea graduates in this country. He therefore framed a resolution, which was passed by the Section, recommending that the British Association Council should form an *ad hoc* Sub-Committee to take stock of existing facilities in this country for training food scientists and technologists; to suggest realistic schemes of tuition and training; to consider means for the extension of facilities for training top-grade technologists; and to consider how existing food research associations can play a fuller part. Dr Corran made special reference to the new universities, indicating that here was a splendid opportunity for one of them to create a department or faculty which would not only permit study for degrees in science, but also provide a postgraduate school for food research and studies in food technology. He stressed that such a department should be closely associated with the various government and industrial food research associations. Many of our leading food technologists have received their training in these research associations, which have a still more important part to play in the immediate future in the training not only of British students but particularly those from overseas.

J. W. C.

HYDROGEN AND THE PERIODIC TABLE

By L. DAVIES, B.SC., A.R.T.C.S., A.R.I.C.

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With regard to the recent correspondence (*J.*, 1960, 413, 451; 1961, 36) under the heading 'How Does the Periodic Table Begin?', recourse to some simple data is of interest, and illustrates various factors which may be considered in discussions of Periodic relationships.

The tendency of hydrogen to form protons may be compared, by consideration of ionization energies, with the tendencies of other elements to form unipositive cations. A few examples are given in Table I.

TABLE I

(In all Tables, energy values are given in kcal/mole)

Process	Ionization energy (kcal) (0°K)
$H_{(g)} \longrightarrow H^+_{(g)} + e$	+313·6
$Li_{(g)} \longrightarrow Li^+_{(g)} + e$	+124·3
$Na_{(g)} \longrightarrow Na^+_{(g)} + e$	+118·5
$Cs_{(g)} \longrightarrow Cs^+_{(g)} + e$	+ 89·7
$F_{(g)} \longrightarrow F^+_{(g)} + e$	+401
$Cl_{(g)} \longrightarrow Cl^+_{(g)} + e$	+298·7
$C_{(diamond)} \longrightarrow C^+_{(g)} + e$	+384·1

Data taken from C. E. Moore, *Atomic Energy Levels* (National Bureau of Standards Circular No. 467, 1949) and J. Sherman, *Chem. Rev.*, 1932, **11**, 93.

In this respect, it may be noted that hydrogen is markedly different from the alkali metals, and is in fact much more comparable to the halogens. The carbon value (heat of sublimation plus ionization energy) is included as a further indication of the difficulty of ionizing hydrogen atoms. The value indicates that it is not immensely more difficult to convert *diamond* into gaseous carbon cations than it is to convert *already-dissociated gaseous hydrogen* into gaseous hydrogen cations. The covalent character of anhydrous hydrogen fluoride indicates that not even the most electronegative element can completely remove the electron from the hydrogen atom. (Contrast the behaviour of the alkali metals.)

If one considers the production of hydrated cations from the elements in their standard states, one may envisage the process as proceeding hypothetically in three stages (Table II):

(i) The sublimation or dissociation of the element to form gaseous atoms;

(ii) The ionization of these atoms to form gaseous cations;

(iii) The hydration of the gaseous cations so formed.

The corresponding energy terms are:

(i) Sublimation or dissociation energy;

(ii) First ionization energy;

(iii) Hydration energy.

$\Delta H_{(\text{hydrated cation})}$ is the heat of formation of the hydrated cation from the element in its standard state, calculated from the energy terms given.

TABLE II

Process					$\Delta H_{(\text{hydrated cation})}$ (kcal)
	Stage (i)	*Stage* (*ii*)	*Stage* (*iii*)		
$\frac{1}{2}H_{2(g)}$	$\xrightarrow{+52}$	$H_{(g)}$ $\xrightarrow{+314}$	$H^+_{(g)}$ $\xrightarrow{-280}$	$H^+_{(aq)}$	+86
$Li_{(s)}$	$\xrightarrow{+38}$	$Li_{(g)}$ $\xrightarrow{+124}$	$Li^+_{(g)}$ $\xrightarrow{-123}$	$Li^+_{(aq)}$	+39
$Na_{(s)}$	$\xrightarrow{+26}$	$Na_{(g)}$ $\xrightarrow{+119}$	$Na^+_{(g)}$ $\xrightarrow{-97}$	$Na^+_{(aq)}$	+47
$Cs_{(s)}$	$\xrightarrow{+19}$	$Cs_{(g)}$ $\xrightarrow{+90}$	$Cs^+_{(g)}$ $\xrightarrow{-63}$	$Cs^+_{(aq)}$	+46

It is seen that hydrogen is considerably nearer in its behaviour to the alkali metals when water is present than when it is absent. But even when hydration occurs, hydrogen ions are less likely to form than are alkali-metal cations. Hydrogen ions form in chemical systems only if there is present a solvent which effectively solvates the protons. Similarity of hydrogen to the alkali metals is therefore restricted to such circumstances.

In contrast to the non-existence of H^+, the hydride ion H^- does exist in a limited number of compounds. A comparison of hydrogen with the halogens may be made by considering the relative ease of formation of gaseous and hydrated anions (Table III).

In the processes to which Table III refers, the stages are:

(i) Dissociation;

(ii) Take-up of electrons by the gaseous atoms, to form the corresponding gaseous anions;

(iii) Hydration of these anions.

The corresponding energy terms are:

(i) Dissociation energy;

(ii) First electron affinity;

(iii) Hydration energy.

The heats of formation of the gaseous and hydrated anions ($\Delta H_{X^-(g)}$ and $\Delta H_{X^-(aq)}$, respectively) are calculated from the energy terms given.

TABLE III

Process				kcal
	Stage (i)	*Stage (ii)*	*Stage (iii)*	
	+52	−17	H_2O Immediate	
$\frac{1}{2}H_{2(g)}$	$\longrightarrow H_{(g)}$	$\longrightarrow H^-_{(g)}$	$\longrightarrow$ hydrolysis	$\Delta H_{H^-(g)} = +35$
	+19	−84	−123	$\Delta H_{F^-(g)} = -65$
$\frac{1}{2}F_{2(g)}$	$\longrightarrow F_{(g)}$	$\longrightarrow F^-_{(g)}$	$\longrightarrow F^-_{(aq)}$	$\Delta H_{F^-(aq)} = -188$
	+28·5	−88	−89	$\Delta H_{Cl^-(g)} = -59{\cdot}5$
$\frac{1}{2}Cl_{2(g)}$	$\longrightarrow Cl_{(g)}$	$\longrightarrow Cl^-_{(g)}$	$\longrightarrow Cl^-_{(aq)}$	$\Delta H_{Cl^-(aq)} = -148{\cdot}5$
	+23	−82	−81	$\Delta H_{Br^-(g)} = -59$
$\frac{1}{2}Br_{2(g)}$	$\longrightarrow Br_{(g)}$	$\longrightarrow Br^-_{(g)}$	$\longrightarrow Br^-_{(aq)}$	$\Delta H_{Br^-(aq)} = -140$
	+18	−75	−72	$\Delta H_{I^-(g)} = -57$
$\frac{1}{2}I_{2(g)}$	$\longrightarrow I_{(g)}$	$\longrightarrow I^-_{(g)}$	$\longrightarrow I^-_{(aq)}$	$\Delta H_{I^-(aq)} = -129$
		+26	−17	
(note also *e.g.* $Na_{(s)}$		$\longrightarrow Na_{(g)}$	$\longrightarrow Na^-_{(g)}$	$\Delta H_{Na^-(g)} = +9$)

The data for the formation of gaseous anions show clearly that hydrogen is notably different from the halogens, the formation of H^- alone being endothermic. The hydride ion therefore exists in far fewer compounds than does any halide ion. Further, the heat of formation for the gaseous hydride ion is quite out of order with the trend of values for the halide ions.

The hydride ion is totally different from the halide ions in that it cannot exist in aqueous solution. The reason why the hydrated hydride ion is unknown is that there is a very marked tendency for hydrogen to exist, not as positive or negative ions, but in covalent form. The hydride ion therefore reacts vigorously with even the small trace of hydronium ions present in water, to form undissociated hydrogen. One might add that it appears unlikely that solvation could materially stabilize the hydride ion relative to the halide ions, even if solvolysis did not occur. This conclusion is based on the fact that the crystallographic radius of H^- is intermediate between those of F^- and Cl^-. Solvation energy for H^- should therefore be intermediate between those for F^- and Cl^-; and the (unknown) reaction $H^-_{(g)} \rightarrow H^-_{(aq)}$ should be exothermic to the extent of about 105 kcal. The hypothetical heat of formation of hydrated hydride ions thus derived ($\Delta H = -70$ kcal) may be compared with the corresponding (experimental) values for the halide ions (Table III). The hydride ion must always be much more rare than halide ions.

The evidence thus suggests that the chemistry of hydrogen is not particularly like that of either the halogens or the alkali metals. The fact is that the chemistry of hydrogen is predominantly covalent, ionic forms of the elements being possible only under exceptional circumstances—the possibility of solvation, or of combination with the least electronegative elements. A particularly graphic way of expressing the difficulty of forming $H^+_{(g)}$ and $H^-_{(g)}$ is to observe that it is easier to form $Cl^+_{(g)}$ and $Na^-_{(g)}$, respectively (starting from elements in standard states). One is reminded of the suggestion by Reinmuth (*J. chem. Educ.*, 1957, **34**, 272) that, disregarding the inevitable univalence, hydrogen be placed at the head of Group IVB.

This idea is not without interest. It classifies hydrogen with other elements whose chemistry is markedly covalent, and numerical values for certain properties of hydrogen fall into line with the general trend in the subgroup. Values for ionization energies and electron affinities are given in Table IV. It should be stated that the values for the latter property are relatively uncertain; those quoted are from Pritchard, *Chem. Rev.*, 1953, **52**, 529.

TABLE IV

	Ionization energy (kcal; 0°K)	Electron affinity (kcal; 298°K)
H	+313·6	−17
C	+260·6	−19
Si	+188·0	−62 ± 11
Ge	+187·5	—
Sn	+169·0	—
Pb	+170·9	—

Thus, though hydrogen is completely different from the elements of Group IVB as regards, say, atomicity, it has values for thermodynamic properties which fit in with those of carbon and its homologues. In contrast, hydrogen resembles the halogens in atomicity, and yet has thermodynamic values which do not suit the trend for the halogens.

Nothing has been said so far of that fundamental property, electron configuration. Various authors have classified hydrogen with the alkali metals on grounds of similar electron configuration (H $1s^1$, Li $2s^1$, Na $3s^1$, etc.). One must note, however, that the atom of hydrogen is quite different from those of the alkali metals in that the valency electron is unshielded by any inner electrons,

and we have already discussed the limited similarity in quantitative behaviour between hydrogen and the alkali metals.

In other instances, the electron configuration of hydrogen is invoked to classify the element with the halogens, since the configuration is one electron short of an inert-gas configuration. Thirdly, one may consider the electron configuration of hydrogen as being a half-full valency shell, and therefore (following Reinmuth) regard the element as being comparable to carbon and its homologues. In each case, there is limited similarity of behaviour.

Therefore, no unambiguous conclusion as to the position of hydrogen in the Periodic Table appears possible from a qualitative consideration of electron configurations, and a quantitative thermochemical approach, such as that developed above, serves to confirm this view.

It seems clear that the chemistry of hydrogen is not adequately indicated by assigning the element to any single position in the Periodic Table.

The writer is indebted to Mr D. Bailey for helpful discussion.

SMITHSON TENNANT, 1761-1815

By K. R. WEBB, B.SC., PH.D., F.R.I.C.

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'No man that Great Britain has produced was better fitted to have figured as an analytical chemist, both by his uncommon chemical skill, and the powers of his mind, which were of the highest order, than Mr Smithson Tennant, had he not been in some measure prevented by a delicate frame of body. . . .' So begins Thomas Thomson's account,[1] in his *History of Chemistry*, of the life and work of the discoverer of the two platinum group metals, osmium and iridium.

Smithson Tennant was born just 200 years ago on 30 November, 1761, at or near Selby, Yorkshire, and was christened in Selby Abbey Church on 3 December.[2] He was the only child of the Rev. Calvert Tennant and his wife (*née* Mary Daunt). Calvert Tennant was himself the youngest son of a respectable Yorkshire husbandman, and was born at Mount-Parke in Wensleydale, near Richmond, Yorkshire. He became curate of Castleford, Yorkshire, about 10 miles from Selby; he was also Rector of Great Warley, Essex, in 1758–72, but seems to have been mainly non-resident.[3]

Young Smithson early showed an interest in chemistry; his first recorded experiment, made when he was about nine years old, was the preparation of some gunpowder for fireworks, 'according to directions contained in some scientific book to which he had access,' says Thomson. About this time, however, his father died, after which sad event the boy's education was rather irregular and neglected.

Eventually he was sent to Beverley Grammar School[4] in about 1776, and from there went to study medicine at Edinburgh University in 1781, enrolling for classes in anatomy and surgery, chemistry and materia medica;[5] he was thus able to lay a sound foundation to his chemical knowledge by attending the lectures of the celebrated Dr Joseph Black (1728–99), of latent heat and 'fixed air' fame. It should, too, be mentioned that before he reached the age of manhood Smithson also lost his mother; she was thrown from her horse whilst riding with him, and was killed on the spot.

On 30 October, 1782, he entered Christ's College, Cambridge, and spent much of his time there on his favourite study, chemistry, but worked also at botany and mathematics. According to Thomson, he 'mastered the most important parts of Newton's *Principia*.' A delightful picture of Tennant as an enthusiastic young chemist is given by old Henry Gunning in his gossipy *Reminiscences*:[6] 'He was passionately fond of chemistry, to which he devoted the greater part of his time, even in his Undergraduateship, frequently forgetting the hour of dinner. When at a loss for a piece of linen to filter some of his preparations, he never scrupled taking a part of a cambric handkerchief for the purpose, or cutting a piece off a shirt.' Another account of his activities at Cambridge tells us that his college room was a scene of confusion—books, papers and chemical apparatus littered the floor.[7]

In 1784, Tennant travelled through Denmark and Sweden, his main purpose being to become personally acquainted with Scheele, the great Swedish practical chemist and discoverer, for whom he had the highest admiration. Evidently their meeting was a success, and Tennant, on his return to England, took great pleasure in showing his Cambridge friends the mineralogical specimens which Scheele had given him. In later years, when he had also become well known to Berzelius, the latter said that Tennant always carried in his pocket a map of Sweden which had become worn and soiled from many years of use.

Towards the end of 1786, Tennant transferred from Christ's to Emmanuel College, Cambridge, and in 1788 took his M.B.[8] He was already a Fellow of the Royal Society (1785), and ultimately took his M.D. at Cambridge in 1796, but as he had ample private means, and a very sensitive nature, he seems never to have practised.

The untidiness of Tennant's college room has already been mentioned, and this was but one example of a certain fecklessness and near-bohemianism which marked many of his activities. Gunning again gives this quaint but exasperating picture of Tennant's preparations for foreign travel, of which he was rather fond: 'During his residence at Emmanuel, he agreed to accompany a friend to France, who, knowing his want of punctuality, thought it better they should travel to town in a post-chaise, as Tennant would be sure to miss the coach. The time was fixed for starting; the request that he would be ready when his friend called for him, was faithfully promised but not adhered to, for when the post-chaise stopped to take him up, he had not finished breakfast. His friend complained bitterly at the detention, and his annoyance was much increased when Tennant said, "I have only to drink my cup of tea, and shall then have nothing to do but to pack up."

'This unlooked-for information was scarcely to be endured; but when witnessing the process of packing up, his anger was converted into a hearty laugh. Tennant first removed the breakfast things, and then spread the table-cloth on the floor; upon this he emptied, with the utmost composure, the contents of a drawer which contained his linen; then getting a second table-cloth of larger dimensions, he emptied into that the contents of another drawer, consisting of coats, waistcoats, etc.; to these he added shoes, boots, and brushes; and tying up the corners in the same manner that college laundresses carry away the dirty linen, he announced he was ready. These two bundles were crammed into the chaise, and the two friends started.'

With this happy-go-lucky nature went, however, a real vein of practical kindliness, as can be seen from this story told by Thomson: 'He had a steward in the country, in whom he had long placed implicit confidence, and who was considerably indebted to him. In consequence of this man's becoming embarrassed in his circumstances, Mr Tennant went into the country to examine his accounts. A time and place were appointed for him to produce his books, and show the extent of the deficiency; but the unfortunate steward felt himself unequal to the task of such an explanation, and in a fit of despair put an end to his existence. Touched by this melancholy event, Mr Tennant used his utmost exertions for the relief and protection of the family whom he had left, and not only forgave them the debt, but afforded them pecuniary assistance, and continued ever afterwards to be their friend and benefactor.'

It is now high time to say something about Tennant's contributions to science.[9] Having taken his M.B. at Cambridge in 1788, Tennant soon after took up residence in London, where from about 1793 till the end of his life he had lodgings in the Temple. His first important chemical work, published in the *Phil. Trans.* for 1791, dealt with the analysis of 'carbonic acid.' Thomson tells us: 'His mode was to pass phosphorus through red-hot carbonate of lime. The phosphorus was acidified, and charcoal deposited.' This result confirmed Lavoisier's view that 'carbonic acid' (CO_2) was composed simply of carbon and oxygen. In 1796, Tennant proved experimentally that the diamond is pure carbon (published in the *Phil. Trans.* for 1797). Again Thomson tells us his procedure: 'His method was to heat it [*i.e.* the diamond] in a gold tube, with saltpetre. The diamond was converted into carbonic acid gas, which combined with the potash from the saltpetre, and by the evolution of which the quantity of carbon, in a given weight of diamond, might be estimated.' Thomson further tells us, on the authority of the afterwards-famous William Hyde Wollaston (1766–1828), that during the above-described experiment, at which he, Wollaston, was acting as assistant, Tennant suddenly noticed that it was time for him to take his habitual ride on horseback, whereupon he left the experiment to be finished by Wollaston and went off for his canter—all very much in keeping with the stories already related!

Also, in 1797, and probably resulting from the work just described, Tennant published a paper 'On the action of nitre on gold and platina' (*Phil. Trans.*, 1797).

During the next few years, Tennant studied practical agriculture, in particular the beneficial effects of the liming of soils. In the course of these studies, however, he showed in 1799 that lime made from magnesian limestone is injurious to vegetation. In the same year he bought a large tract of waste land near Cheddar (Somerset), where he built a small house which he used as a summer residence, and carried out his agricultural experiments. Thomson says: 'These farming speculations, as might have been anticipated from the indolent and careless habits of Mr Tennant, were not very successful.' However, some years later (1812) Berzelius, visiting Tennant, was shown the latter's experimental 100-acre oat field in which lime had been mixed with soil in decreasing ratio from one end to the other. At the well-limed end the plants were healthy and well developed, and at the other end were sickly. They also visited together Tennant's experimental lime kiln designed by himself.[10]

In 1803 Tennant began his careful studies on crude native platinum; these resulted in his most important discovery—the one for which he is still remembered—of the two platinum group metals, iridium and osmium. What essentially he did was to show that the black powder left after treating native platinum with aqua regia 'did not, as was generally believed, consist chiefly of plumbago [i.e. graphite] but contained some unknown metallic ingredients.' At first he tried to alloy lead with the black powder; later he found a means of separating the dark material (osmiridium) into its two constituents by the alternate action of caustic alkali and acid. One of these constituents, the existence of which had also been observed about the same time by the French chemists, Descotils, and Vauquelin and

Fourcroy, was named *iridium* by Tennant (Greek—iris = rainbow), on account of the variety of colours shown when it dissolved in hydrochloric acid.[11] The other constituent could be liberated from the alkaline system as a volatile oxide; this he at first called *ptene*[12] (Greek—ptenos = winged), but he later decided on the name *osmium* (Greek—osme = a smell), on account of the peculiar odour associated with the volatile material. Tennant published his findings in a paper 'On two metals (osmium and iridium) found in the black powder remaining after the solution of platina' in the *Phil. Trans.* for 1804 (pp. 411–418). For this work he received the Copley Medal of the Royal Society.

According to Thomson, 'Mr Tennant's health, by this time, had become delicate, and he seldom went to bed without a certain quantity of fever, which often obliged him to get up during the night and expose himself to the cold air.' Could it have been that he was suffering from the after-effects of inhaling poisonous volatile heavy-metal compounds? Thomson further says: 'To keep himself in any degree of health, he found it necessary to take a great deal of exercise on horseback. He was always an awkward and a bad horseman, so that these rides were sometimes a little hazardous; and I have more than once heard him say, that a fall from his horse would some day prove fatal to him. In 1809 he was thrown from his horse near Brighton, and had his collar-bone broken.'

A few years later, in May, 1813, Tennant was elected Professor of Chemistry at Cambridge; he had been urged by his friends to become a candidate for the vacant chair, and he probably agreed more from his customary good nature than from any need of an official position. He was required to give 20 lectures a year, but only lived to give his course once, in 1814. The lectures were very well received.

Berzelius gives us a very clear picture of the ageing Tennant (he was, however, only 52) in 1813 in a letter to his friend and countryman, the Swedish chemist, mineralogist and mining engineer, J. G. Gahn:[13] 'Tennant is of about the same age as Wollaston'—actually Wollaston was five years younger—'but is grey-haired and looks like an old man. He is a charming man, gets off a lot of droll ideas which entertain any sort of society, scientific or otherwise. He is a rather good, reliable chemist, but doesn't have either Wollaston's or Davy's head; and now he has lost much of his memory, so that one can tell him the same thing on two successive days with full assurance that it will be new to him. He is badly dressed, is careless of his appearance, and makes a poor showing. His chemicals are so helter skelter that he gets permission to pull out all the table drawers in the parlour to convince himself of the absence of what one would never expect to find except in a laboratory.'

As Tennant had forecast, he met his untimely death through a riding accident. It happened at Boulogne-sur-Mer on 22 February, 1815. Being delayed by an adverse wind from crossing the Channel, he had ridden out with an acquaintance to inspect a column erected to Napoleon a few miles outside the town, and also a small fort. When approaching the latter a drawbridge had to be crossed. Unfortunately the bolt which should have secured this bridge had been stolen a fortnight before,[14] with the result that the bridge tilted and threw Tennant and his horse into the ditch. When picked up, from under the horse, he was almost dead of a fractured skull, and although carried at once to the Civil Hospital he died within the hour. He was buried at Boulogne, many of the English residents attending his funeral.

Finally it should be mentioned that in addition to his scientific interests, Tennant was a man of considerable and diverse culture; the works of Virgil, Milton, Pascal, Gray, Handel and Raphael all afforded him intense pleasure, according to one account.[15] Another written after his death stated:[16] 'To those who had the happiness of being intimately connected with him he was endeared by his virtuous independent principles, and the sincerity, warmth, and constancy of his friendship. To this may be added a very original cast of humour in his character and manners, and a singular felicity of wit, untinctured by personality or sarcasm, which rendered his conversation delightful to his friends, and made it impossible to know him much, without admiring and loving him.' Admittedly this smacks rather of the typical Georgian memorial tablet, but all allowances being made, there seems no doubt that the discoverer of osmium and iridium was a quaint, delightful and very English character.

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5. From information supplied by the Matriculation Office of the University of Edinburgh.
6. H. Gunning, *Reminiscences of the University, Town and County of Cambridge from the Year 1780*, London, 1854, **2**, 59–62.
7. M. E. Weeks, *Discovery of the Elements*, 5th Edition, Easton, Pa., 1945, 256.
8. J. A. Venn, *Alumni Cantabrigienses*, Cambridge, 1954, Part II, **6**, 140—entry for Smithson Tennant.
9. Lists of the scientific papers published by Smithson Tennant are to be found in: (*a*) J. C. Poggendorff, *Biographisch-Literarisches Handwörterbuch zur Geschichte der Exakten Wissenschaften*, Leipzig, 1863, **2**, 1079–1080; (*b*) *Royal Society Catalogue of Scientific Papers, 1800–1863*, London, 1871, **5**, 931.
10. M. E. Weeks, *op. cit.*, 258.
11. D. McDonald, The Discovery of Iridium and Osmium—Bicentenary of Smithson Tennant, *Platinum Metals Review*, 1961, **5**, 146–148.
12. J. Newton Friend, *Man and the Chemical Elements*, London, 1951, 303.
13. M. E. Weeks, *op. cit.*, 258.
14. D. McDonald, *op. cit.*, 148.
15. M. E. Weeks, *op. cit.*, 259.
16. *The Gentleman's Magazine*, 1815, **85**, 281.

Book Reviews

CHEMISTRY OF CARBON COMPOUNDS. VOLUME IV. HETEROCYCLIC COMPOUNDS. PART C. Edited by E. H. Rodd. Pp. xviii + 1465–2201. *Amsterdam: Elsevier Publishing Co.; London: D. Van Nostrand Co. Ltd*, 1960. 130*s*.

To attempt a survey of the field of heterocyclic compounds in three conveniently-sized volumes was a challenging undertaking, fraught with many great difficulties. Now, with the appearance of Volume IV C, this immense task has been brought to triumphant completion. Contributors, editor, editorial board and publisher deserve the greatest praise. Volume IV of 'Rodd' is so well conceived and executed that it is a real pleasure to use and read. It provides remarkably easy access to a vast quantity of chemical knowledge, and the reader can rapidly and with little effort become well informed on the section of his choice, whether it concerns some obscure heterocycles or a ring system that has been widely studied. The treatment is surprisingly exhaustive within its 2,000-odd pages, but the work is certainly not exhausting to read because the chapters are so well balanced and interesting.

In the latest Part, C, the comprehensive survey of heterocyclic compounds is concluded by discussions of the following subjects: oxazines and thiazines and their benzo and dibenzo analogues, dioxans and benzodioxans (G. R. Ramage, E. H. Rodd and J. K. Landquist); dyes based upon the phenazine, phenoxazine and phenothiazine systems (H. T. Howard and G. R. Ramage); triazines, tetrazines, oxa- and thia-diazines, di-oxazines and -thiazines, trioxans and trithians (E. Hoggarth); and compounds having a 7-membered or larger ring containing one or more hetero atoms (P. M. Maitlis). Then come chapters on purines and their derivatives (G. A. Howard), nucleosides, nucleotides and nucleic acids (J. Baddiley), and pteridines, alloxazines, vitamins B_2, B_1 and related compounds (G. R. Ramage and T. S. Stevens). These topics have been separated from the accounts of the chemistry of the relevant parent ring systems because of very considerable intrinsic importance. Finally, the volume is rounded off with seven chapters which are devoted to the various branches of alkaloids and cover in a very concise manner the pyrrolidine, pyridine, piperidine, pyrrolizidine and tropane alkaloids, and those of the quinoline, isoquinoline, lupinane, iminazole, quinazoline, diterpene and steroid groups (A. R. Pinder); alkaloids of the morphine group (K. W. Bentley); the indole alkaloids (G. F. Smith); and erythrina alkaloids (A. R. Pinder). Over 1,000 of these physiologically active, basic compounds which occur in the plant kingdom have now been investigated. Structurally they do not form a closely related group and they are therefore classified by their nitrogen-containing ring to which the chemistry in large measure relates. Even so there are considerable advantages from a treatment separate from that of the parent rings.

Part C of Volume IV continues the extremely high standard set by the previous Parts, and so doubtless all the proud possessors of Parts A and B will already have acquired the final volume. It is to those chemists who have not yet experienced the delight and usefulness of possessing all or part of 'Rodd' that my concluding remarks must be addressed.

Here is a very complete organic chemists' reference book—a 'pocket Beilstein'—which is exceptionally readable. To all who have interests in alkaloids, nucleotides and nucleic acids, pteridines, purines, or other of the topics summarized above, this Volume IV C is strongly commended. The purchase of the one volume may well lead to a desire for others, but the price is not high when the value is considered.

J. A. ELVIDGE

HANDBOOK OF CHEMISTRY AND PHYSICS. Forty-second Edition. Pp. xxv + 3481. 105*s*.

TABLES FOR IDENTIFICATION OF ORGANIC COMPOUNDS. (Supplement to *Handbook of Chemistry and Physics*.) Pp. vii + 241. 60*s*.

Edited by C. D. Hodgman, R. C. Weast and S. M. Selby. *Cleveland: The Chemical Rubber Publishing Co.; Oxford: Blackwell Scientific Publications Ltd*, 1960.

The *Handbook of Chemistry and Physics* needs no introduction, and most laboratories have a copy of this well-known work of reference. The latest edition, the forty-second, follows the usual pattern and contains a wealth of information relating to many branches of science and technology. In continuing their policy of providing the most up-to-date information, the editors have made such revision as they consider necessary. In certain instances entire tables have been revised, in others only partial revision was required. Among the revised and expanded sections are those concerned with atomic weights, electronic configurations of the elements, trade names of plastics, analytical reagents, volumetric primary standards, drying agents, properties of refractory materials, nuclear spins and definitions.

As is usual in each fresh edition, new tables of data have been added. This year the tables cover a wide range of subjects, for example there is new information on the diffusion of metals into metals, diffusion of solute elements in body-centred cubic titanium and titanium alloys, triple points and boiling points of some low-boiling elements, dissociation pressure of calcium carbonate, initial permeability of high-purity iron at various temperatures, interplanetary orbits, components of atmospheric air, conversion formulae for solutions having concentrations expressed in various ways, standard types of stainless steels, and the composition of electrolytes for mercury half-cells as used in polarographic analysis. There is additional material relating

to organic compounds, including tables on bond lengths between carbon and other elements, sublimation data, miscibility data, dissociation constants of organic acids and bases in aqueous solution, and the surface tensions of organic solutes in water and of organic compounds in organic solvents. The surface tensions and dissociation constants of some inorganic compounds are also included.

Tables for Identification of Organic Compounds is an entirely new reference book devoted exclusively to data relevant in qualitative organic analysis. Included in the tables are the main representatives of the more common classes of organic compounds (more than 4,380 parent compounds are arranged under 17 headings). Thousands of additional physical constants of organic derivatives not found in the 'Handbook' are listed. This compact volume is a valuable supplement to the *Handbook of Chemistry and Physics* and is likely to become widely used by organic chemists.

W. G. OVEREND

XVIITH INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY. VOLUME I: INORGANIC CHEMISTRY. Pp. 341. *London: Butterworths; Weinheim: Verlag Chemie GmbH*, 1960. 63*s*.

This volume presents the plenary lectures and the section lectures at the conference which was held in Munich in September, 1959. Of the 19 contributions, 11 are in English, five in German and three in French. The variety of the contents can best be illustrated by the titles of the plenary lectures, and of the sections under which section lectures were presented.

The plenary lectures dealt with: Bildungsmechanismus der Metall-Kohlenstoff-Bindung und einige Aspekte über die Reaktionsfähigkeit metallorganischer Verbindungen der Schwermetalle (O. A. Reutow); Chemical Behaviour and Bonding of Boron Hydride Derivatives (A. B. Burg); Comparative Chemistry of the Lanthanide and Actinide Elements (B. B. Cunningham); Compounds of Fluorocarbon Radicals with Metals and Non-Metals (H. J. Emeléus); Ionenreaktionen in nichtwassrigen Lösungen (V. Gutmann); Recherches récentes sur l'oxydation et la sulfuration des métaux au voisinage des conditions d'équilibre (J. Bénard).

The sections covered were: compounds with metal–carbon bonds (G. Wilkinson, E. G. Rochow); hydride chemistry (J. Chatt and B. L. Shaw, H. C. Brown); chemistry of actinides and lanthanides (M. Haïssinsky); chemistry of fluorine and fluorides (G. H. Cady); preparation of super purity metals (A. E. van Arkel, G. Chaudron); water-like solvents (C. C. Addison); homogeneous and heterogeneous gas equilibria (K. Wieland); semi-conductors and compounds of semi-metals (C. S. Fuller); ternary oxides and sulphides (E. W. Gorter); and documentation (R. Fugmann).

The plenary lectures, as might be expected, give fairly broad surveys of important regions of inorganic chemistry and are excellent summaries of the state of knowledge at the time when they were delivered. The section lectures inevitably deal with narrower topics, but most of these, also, avoid too much detail and are eminently readable accounts of advancing fields of study.

To select any of the papers for special mention would merely be to indicate personal preferences in respect of one topic as distinct from another and would be no indication of the merit of the papers so selected. Whatever may be the benefit of publishing conference proceedings in this way—and on this there is room for opposing views—this volume is of a high standard in its genre. It is well worth the time and attention of those inorganic chemists (and, indeed, other chemists) who wish to get a picture of what is going on in fields outside their own.

CECIL L. WILSON

FATTY ACIDS. THEIR CHEMISTRY, PROPERTIES, PRODUCTION, AND USES. Second Edition. Edited by K. S. Markley. *New York and London: Interscience Publishers.* Part I, pp. ix + 714, 1960, 169*s*. Part II, pp. ix + 715–1485, 1961, 207*s*.

These are the first two books of a four-volume work which is to be the successor to Markley's single-volume *Fatty Acids: Their Chemistry and Physical Properties*, published in 1947. The complete plan of the new work has not, to the reviewer's knowledge, been disclosed by the publishers, so it is not possible to assess the balance of the whole work from the chapter headings of the unpublished volumes. Librarians considering the purchase of the whole work—and who else, despite its excellent production, will contemplate buying a work as expensive as this?—will have to take the contents of Parts III and IV on trust. The work is stated by the publishers to be completely re-written and, despite the enlistment of a proportion of specialist authors, to have the 'uniformity of treatment and clarity of style characteristic of a book conceived and carried out by one man.'

The first three chapters of Part I, by Markley himself, are: 'Historical and General' (short and colourful); 'Nomenclature, Classification and Description of Individual Acids'; and 'Isomerism.' The last two occupy 260 pages, yet the coverage is not as complete as it should be. Space is wasted on trivial information about lower saturated and unsaturated acids, yet there are major gaps in topics such as bacterial fatty acids and natural acetylenic acids. Older and simpler topics seem preferred to newer or more complicated ones. Although history and natural occurrence normally receive their due, synthetic methods are dealt with uncritically or not at all. For example, Noller and Girvin's early but unsatisfactory synthesis of linoleic acid is given more space than three modern ones put together (p. 150), and none is adequately described. The fact that an acid has been totally synthesized may be overlooked, as in

the case of ximenynic acid (p. 211) or, on p. 146, stillingic acid from *Sapium sebiferum* (in this case synthesis establishes the *trans*-2-, *cis*-4 configurations, which is not given). A number of other cases where the literature has either been poorly surveyed or the search has been terminated before 1955 were noted. Incorrect physical data are given for (±)-ricinoleic acid (p. 190), the wrong stereochemistry is assigned to punicic acid, and work finally disproving the existence of trichosanic acid is overlooked (pp. 160, 259, 272). This makes one uneasy about the publisher's claim of 'uniformity of treatment' throughout the work, for on p. 441 O'Connor states the position regarding punicic and trichosanic acid correctly. Other weaknesses in chemical scholarship were found on p. 116 where, discounting an obvious formula error, a strange semi-mechanistic scheme is attached to the Fittig $\beta\gamma$-unsaturated acid synthesis.

The chapter on isomerism is weak, and there is much that is trivial and obvious. Geometrical isomerism is dealt with in a rather out-of-date way, and where guidance is really wanted it is sometimes not given. This was especially noticed in connection with absolute configuration. The general obscurity is illustrated by (p. 49): 'Klyme [*sic*] (30a) concluded from a consideration of the anteiso acids that the (+)-anteiso-alkanoic acids are represented by a Fischer projection formula and may be termed L-methyl substituted acids.' The single reference gives a clue that the literature searching was not complete, and the sentence is hardly informative as it stands. There is nowhere an explanation of the Linstead, Lunt and Weedon convention or the Cahn, Ingold and Prelog notation. The problems of absolute configuration in the fatty-acid field are never stated, and the personal symbolism of the author whose paper is being discussed is abstracted directly, leaving the reader to sort the matter out for himself.

Two chapters by R. T. O'Connor, on X-ray diffraction and polymorphism (chapter 4) and spectral properties (chapter 5), are attractively written and give excellent short accounts of the basic physical methods. Difficulties are not avoided, and the writing is clear and objective on vexed questions such as the polymorphism of glycerides. The author's eyes are open to the possible employment of less popular regions of spectroscopy such as Raman, near infra-red and microwave, to yield to the organic chemist gleanings of information not available from the more powerful trinity of ultra-violet, infra-red and nuclear-magnetic-resonance spectra.

The final two chapters of Part I are 'Properties of the Liquid State' and 'Solution Properties,' both by W. S. Singleton. Under these headings is grouped much physical information on heats of combustion, vapour pressure, densities, viscosities, surface tensions, refractive indices, conductivity and similar constants for fatty acids and their derivatives. Much tabular information is given, together with short accounts of the methods employed in the various fields.

Part II contains three chapters by Markley entitled 'Salts of Fatty Acids,' 'Esters and Esterification,' and 'Hydrogenation.' The first is mainly of commercial interest, detailing uses in a variety of industries. As a treatment of the kinetic and mechanistic fundamentals of esterification the second chapter is unsatisfactory and tends to concentrate on older information. But it is a valuable source of information, especially on topics such as glyceryl esters. The chapter on hydrogenation also contains useful information on both chemical and catalytic aspects, but it is not a well-balanced account. Thus the important laboratory process of reduction of triple to double bonds (p. 1293) is afforded but 15 lines. Only the Robinson and Robinson chemical method is mentioned, and most of the space is used for practical details. There is not even a mention of Lindlar catalyst!

In two chapters by Sonntag, dehydration, pyrolysis and polymerization, and halogenation, dehalogenation and dehydrohalogenation are considered. Some mechanistic setting is provided, and both chapters contain many items of interest diluted with some rather obvious material. Among other interesting items, the reviewer was surprised to deduce (p. 1000) that the reaction of a silver salt of a carboxylic acid with carbon disulphide to give an anhydride, published as a new method in 1957, was in fact discovered by Broughton in 1865. Part II is concluded by chapters on chemical oxidation and oxidation by atmospheric oxygen (autoxidation), written by Swern. These are both clear and informative accounts.

Perhaps the reviewer should be cautious about drawing generalized conclusions from the two volumes, for the diversity of authors brings more unevenness than the publishers would have us believe. It may be, too, that some omissions will be remedied in Parts III and IV. But these books tend to be weak on the pure organic chemical and on the stereochemical aspects, and some chapters are uncritical. Yet, despite his reservations, the reviewer enjoyed reading these books and is deeply appreciative of the labour of the authors. They dig deeply over a wide area of specialized chemistry, and apart from bizarre processes such as a Chinese technique (actually used) for cracking tung-oil to petrol (p. 1024), there are many minor chemical gems of information scattered in its pages and ready for further development. Libraries concerned with fatty-acid chemistry must have these volumes, and so long as readers are clearly aware of their weaknesses, they have a valuable function to perform in initiating new research.

L. CROMBIE

ORGANIC ANALYSIS. VOLUME IV. Edited by J. Mitchell, Jun., I. M. Kolthoff, E. S. Proskauer and A. Weissberger. Pp. vii + 429. *New York and London: Interscience Publishers*, 1960. 102*s*.

This is one of the most readable books on organic analysis that the reviewer has encountered. Detailed

consideration is given to the theoretical and practical aspects of six important aspects.

The first chapter, by A. J. Martin, gives a very good account of the determination of organic peroxides. As peroxides are treacherous in their behaviour and are liable to violent decomposition on elevation of temperature or by mechanical disturbance alone, recommended procedures for their determination are welcome.

A fascinating section on enzyme analytical reactions is given by J. B. Neilands. He emphasizes the analytical and clinical use of enzymes. The advantages and disadvantages of enzyme methods are discussed. Two features deserve special mention, namely the micro-determination of ethanol in blood and the analysis of amino acids.

Gas chromatography is treated satisfactorily by Nogare and Safranski. Principles and descriptions of modern apparatus and techniques are given in detail. High-temperature gas chromatography receives special consideration.

The application of nuclear-magnetic-resonance spectroscopy to organic analysis is dealt with in an authoritative manner by H. Foster. He gives details regarding the principles and use of nuclear-magnetic-resonance spectroscopy and is at pains to point out limitations of the methods employed. An account is given of the basic principles utilized in interpreting high-resolution nuclear-magnetic-resonance spectra of a number of simple compounds. Molecular association, gem splitting, chelation and geometrical isomerism are illustrated by reference to typical resonance spectra. The effect of water is mentioned and examples are given of the investigation of complex structures such as steroids and alkaloids.

A very interesting account of crystallographic methods of analysis is given by Krc. He stresses the value of information from a combined microscopical and X-ray diffraction examination. The principles of morphological structures of polymorphic modifications, optical properties and behaviour on fusion are well illustrated.

The final chapter is by Ke, on the application of differential thermal analysis to high polymers. Basic principles of measurement, mathematical treatment of thermograms, equipment and procedures are considered.

This, the fourth volume of the series, will be of great value to all classes of research chemists. The standard achieved throughout is a very high one. All the information about the newer methods is most reliable and the reviewer is confident in giving the book high recommendation. B. C. SAUNDERS

PHYSICAL CHEMISTRY OF SURFACES. A. W. Adamson. Pp. xiv + 629. *New York and London: Interscience Publishers*, 1960. 96*s*.

This book, based on the author's lecture course in surface chemistry given for a number of years at the University of Southern California, represents a very useful addition to the literature of surface chemistry. Its topics include capillarity, the nature and thermodynamics of liquid–gas surfaces, surface films (soluble and insoluble) on liquid substrates, and the adsorptive properties of solid surfaces; chapters on friction and lubrication, flotation, detergency and foams are inserted in the main stream of development, and are professed to be no more than introductions to their respective fields. The best parts of the book are those that reflect the author's experience as a graduate student of the W. D. Harkins School at the University of Chicago: the measurement of surface tension is dealt with clearly, authoritatively and in some detail; the significance of the contact angle and of the spreading coefficient are lucidly explained; and the section on monomolecular films gives a compact account of a subject which in less skilful hands could be confusing. The chapter on the adsorption of gases and vapours on solids represents a commendable and on the whole successful attempt to give an intelligible account of present-day views on the subject in the relatively small space of 70 pages; particularly useful is the section where numerical results for surface areas from various models of adsorption are compared. The treatment of chemisorption and catalysis, adsorption from solution and the electrical aspects of surface chemistry (such as the zeta potential) is more cursory, but here as elsewhere there are adequate general references to serve as a guide to more detailed treatments.

The style is straightforward and readable, and the exposition commendably lucid, though an occasional jarring note is struck by the use of the verb 'adsorb' in the active voice when the sense clearly demands the passive, *e.g.* on p. 378 'detergent molecules will adsorb at an oil-water interface'; p. 395 'the stabilising effect of such mixed films may lie in the very slow rate at which they desorb'; and p. 397 'its . . . area will be increased and more protein can adsorb.' But such blemishes are rare; and the writing is enlivened by the author's readiness where apposite to state his own views on controversial subjects—'it is better to show one's own thinking, if clearly labelled as such, than to preserve a dry neutrality on all points'—and by the numerous simple quantitative calculations which he introduces by way of illustration. A further useful, and for this kind of book somewhat unusual, feature is the provision of sets of problems at the end of most of the chapters. The author has wisely refrained from attempting a coverage of the enormous literature of the field, and in his choice of references (900 or more) has laid emphasis on the 'coherent and critical development of topics.'

The book is well produced and seems commendably free of misprints; it may be recommended both to students and also to professional chemists who should find it a 'useful bridge between their basic physical chemistry and the proliferating general literature and specialised monographs.' S. J. GREGG

RADIATION CHEMISTRY OF GASES. A.C.S. Monograph No. 151. S. C. Lind, C. J. Hochanadel and J. A. Ghormley. Pp. x + 313. *New York: Reinhold Publishing Corporation; London: Chapman & Hall Ltd*, 1961. 100*s*.

In 1921, the first monograph on radiation chemistry was published under the title *Chemical Effects of Alpha Particles and Electrons*. It was incidentally the second in the series of American Chemical Society monographs. During the past 40 years, interest in radiation chemistry has increased and in the last two decades particularly a considerable amount of experimental information has accumulated. The need for a similar work summarizing developments to date is apparent, but the fact that this work should be by the same author, S. C. Lind, must surely rank as something of an achievement. In this latter work, which is restricted to gaseous systems, he has been assisted by C. J. Hochanadel and J. A. Ghormley.

The first part of the book, covering approximately 80 pages, deals with general principles of radiation chemistry. Although much of this material is now available in other works, the chapters on α-particles as ionizing agents, and on the kinetics of chemical reactions induced by radon, are particularly valuable. In the remainder of the book is brought together information on the gaseous systems that have been studied to date. The wide variety of chemical reactions that may be induced by ionizing radiation is indicated by the chapters on oxidation, hydrogenation and polymerization. In the light of present-day interests, the chapter on mass spectrometry is particularly pertinent.

Not the least valuable feature of the book is its accumulation of more than 600 references to published work, more than half of these being to work published during the past decade. It is to be regretted, however, that the price of the volume is relatively high.

The appearance of this work, together with the publication of *The Radiation Chemistry of Organic Compounds* by A. J. Swallow in 1960, makes all the more apparent the need for a similar work on aqueous systems. Indeed, it is somewhat ironic that the radiation chemistry of gases, which until recently was regarded as the Cinderella of radiation chemistry, should have been served so admirably by this monograph, whereas at the time of writing this review no such work on aqueous systems has appeared, in spite of the vast amount of work done in this field.* G. HUGHES

CLAYS AND CLAY MINERALS. MONOGRAPH NO. 9, EARTH SCIENCE SERIES. Editor-in-Chief E. Ingerson. Pp. ix + 292. *Oxford: Pergamon Press*, 1960. 63*s*.

The U.S. National Conference on Clays and Clay Minerals takes place annually, and this book contains the proceedings of the Eighth Conference, held in Oklahoma in 1959. There are 21 papers and an abstract of a review. The conference covered a wide range of topics within the general field of clay mineralogy and technology. Eight papers might be classified as dealing with the geology of clays, and 13, occupying just over half the total number of pages, with the mineralogy or physical chemistry of clay minerals.

The main structural features of most of the clay minerals are now well established, but the wide variety and complexity of these substances, as well as their technical importance, ensures that there is still a seemingly limitless field for further research. Because of the wide range of subjects, the papers are hard to classify. There are four on thermodynamic or other aspects of the interaction of water with clay mineral surfaces, and from a fundamental viewpoint these are perhaps the most interesting. It is no criticism of these papers to say that they indicate a need for more research in this field, in which some important problems remain to be solved. Two papers deal with the interaction of clay minerals with organic compounds, two with aspects of cation deficiency in micas and two with quantitative mineral analysis of clay mineral mixtures. There is a paper on the synthesis of hectorite, one on cation exchange in mixed-layer minerals and one on the relations between crystallinity and properties in kaolinite. This paper has some beautiful electron micrographs of mullite needles formed on firing. Of the eight geological papers, there are several on clay minerals and geochemical prospecting, including an interesting review of the possible uses of clay minerals in the search for oil.

The general standard of the papers maintains the high level of previous years, and with its predecessors the book provides a good annual review of American progress in this field; it can be recommended as essential reading to any clay mineralogist who wishes to keep in touch with current research. It is well edited, by Dr Ada Swineford, and well produced. A minor criticism could perhaps be that no attempt has been made to group together related papers. Though difficult, this would not be impossible, and would make the book easier to use. H. F. W. TAYLOR

ADVANCES IN INORGANIC CHEMISTRY AND RADIOCHEMISTRY. VOLUME II. Edited by H. J. Emeléus and A. G. Sharpe. Pp. viii + 392. *New York and London: Academic Press*, 1960. 96*s*.

There are now two different series of volumes dealing with recent developments in inorganic chemistry appearing at regular intervals. This prompts one to ask whether there is enough original work being published to enable the high standard of the first volume in this series to be maintained. There is no doubt in the opinion of the reviewer that this is indeed the case.

There are, in all, eight articles, dealing mainly with inorganic chemistry. In the first of these Dunitz and

* *The Radiation Chemistry of Water and Aqueous Solutions*, by Augustine O. Allen, since published, will be reviewed shortly.

Orgel discuss the stereochemistry of ionic solids, and in addition to providing an excellent survey based on ligand-field theory, they develop very effectively the point that stereochemistry *per se* does not tell us anything about the type of bond in a compound. The next article, on organometallic compounds by Eisch and Gilman, bears the stamp to be expected of the latter. An attempt is made to present principles governing the formation of these compounds rather than a mere cataloguing of results. An article by Cady dealing with fluorine-containing compounds of sulphur provides a comprehensive survey of the latest developments in preparative and structural studies on these compounds. Professor Margot Becke-Goehring discusses the amides and imides of the oxyacids of sulphur, a field to which she has made noteworthy contributions. The halides of the actinide elements are dealt with by Katz and Sheft; a refreshing aspect of this article is the interesting discussion of certain experimental techniques and the difficulties inherent in certain methods of investigation. Professor Foss then discusses the structures of compounds containing chains of sulphur atoms. This article was found to be of special interest, the X-ray structural data being effectively correlated with various physical and chemical properties. The next article deals with chemical reactivity of the boron hydrides and related compounds and is by Dr Stone. A wealth of data is presented and critically evaluated. The final article, by Thode, McMullen and Fritze, surveys the use of mass spectrometry in nuclear chemistry; the reviewer found this article most instructive and enlightening as to the application of this technique.

All the articles are of a high standard and appear to the reviewer to be specially suitable for advanced students who need to become familiar with a wide area of inorganic chemistry; it will also prove of great interest to workers in other branches of the subject. It is well printed with both a subject and an author index.

The editors are to be congratulated on the production of a book which should find its way into all chemical libraries.

R. S. NYHOLM

FLAME PHOTOMETRY. J. A. Dean. Pp. viii + 354. *New York: McGraw-Hill Book Company Inc.; London: McGraw-Hill Publishing Co. Ltd*, 1960. 89*s*.

This is probably the most comprehensive volume on flame photometry yet published. It is intended not only to provide an introduction to the principles and practice of flame photometry but also to serve as a practical handbook on the various aspects of the subject. Basically, it is compiled from lectures given on the subject at the Louisiana State University Symposium.

The first chapters are devoted to atomization, characteristics of flames, excitation of metallic spectra, use of organic solvents, the principles of flame photometers, interferences and selection of optimal working conditions, and absorption flame photometry.

In the past, inconsistencies in reported data have arisen because insufficient allowance has been made for variations in different types of atomizers, different flame temperatures and consequent shifts in gas equilibria involving the metal and its compound. Also, failure to distinguish properly between spectral interferences and those derived from other sources has been a disadvantage in the widespread use of the technique. The author points out in the theoretical portion of the book how these difficulties may be overcome.

In the second part of the book individual elements which may be excited to emit radiation in a flame are considered. In each case the nature of the spectrum and the conditions for optimum excitation are outlined, spectral interferences are stated and the types of radiation interference from other metals are listed.

After chapters devoted to the characteristics of individual elements, there is a section on applications, for example clinical biochemistry, soil and agricultural analysis and cement, glass and ceramics.

There is a short appendix giving details of preparation of stock solutions, analytical factors and definitions relating to concentrations and radiant energy.

To a large extent the author has achieved his aims, since the book is written in a clear and lucid style and the practical worker can follow the instructions with ease. In the main, the book is comprehensive. Perhaps greater attention could have been given in the apparatus section to the choice of burners and to various types of atomizers, but in the practical section there is little to criticize. There is a very full bibliography at the end of the book, with 780 references.

The technique of flame photometry is still being developed, but this volume certainly brings the subject up to date for the reader.

R. F. MILTON

CHYMIA. ANNUAL STUDIES IN THE HISTORY OF CHEMISTRY. VOLUME VI. Editor-in-Chief H. M. Leicester. Pp. 210. *Philadelphia: Pennsylvania University Press; London: Oxford University Press*, 1960. 40*s*.

The high reputation of this important series will be well maintained by this volume. Martin Levey, of Temple University, Philadelphia, further widens our perspective of Babylonian chemistry. Professor J. R. Partington gives a characteristically detailed survey of the essentials of Joseph Black's *Lectures on the Elements of Chemistry*. Miss Rhoda Rappaport of Cornell University reconsiders the work and reputation of a great teacher of chemistry, G. F. Rouelle, of whom one pupil said: 'When Rouelle spoke he inspired, he overwhelmed: he made me love an art about which I had not the least notion; Rouelle enlightened me, converted me; it is he who made me a supporter of that science [of chemistry] which should regenerate all the arts one after the other.' Do we have such teachers now?

J. Z. Fullmer, of Tulane University, writing on Humphry Davy as a poet, makes a valuable study of the philosophical side of Davy's character, without which his approach to experiment cannot be fully understood.

Some chemists may feel (quite wrongly in my opinion) that this kind of historical chemistry is remote from modern activity. However that may be, no-one can pass over the later articles in this set; Sister St John Nepomucene of Trinity College, Washington, on Rydberg; Trevor Robinson of Syracuse University on Michael Tswett; and G. B. Kauffman of Fresno State College on the controversy between Werner and the almost-forgotten Jørgensen, a fascinating example of the difference between what Ostwald called the romantic and classical attitudes to research.

The article by E. D. Goldberg (Scripps Institution) on chemists and the oceans contains no deep historical judgments, but is a useful set of notes with a good bibliography.

The existence of this series is in part due to the activities of the American Chemical Society's history of chemistry division. It is a matter for great regret that there is no comparable focus for the history of chemistry in this country. The Society for the Study of Alchemy and Early Chemistry publishes an excellent journal, *Ambix*, but its interests stop at the time of Dalton. If intellectual initiative is anything to go by, it seems that appreciation of the value of historical studies is more easily to be found in the board rooms of the chemical industry than in the council rooms of our chemical societies. It is to be hoped that this will not always be so and that the reviewer of some future volume of *Chymia* will be able to compare it with a corresponding product of a British organization.

FRANK GREENAWAY

THE BOUNDARIES OF SCIENCE. M. Pyke. Pp. 224. *London: George G. Harrap & Co. Ltd*, 1961. 15*s*.

No one who reads this book—be he chemist or physicist, mathematician or biologist, or just an intelligent layman—is likely to dispute that in the collection of its material Dr Magnus Pyke has read widely and thought deeply, and that in writing up the material he has tackled his immense task with gusto and enthusiasm, with effervescence and ebullience. From the opening sentence 'In the modern twentieth-century world science touches us at almost every point' to the closing words 'Purpose, aesthetics, impulsiveness, ethics—these are outside the boundaries of science,' from the first item of the index (absorption spectra) to the last (zoology) an extremely wide variety of topics is touched upon. Just how varied is the fare may be gathered from these index entries: the principle of identity and the uncertainty principle; anti-particles and antibiotics; α-particles and α-rhythm; chromosomes and Ziegler catalysts; conservation of energy and overthrow of parity; encephalographs and spectrographs.

To knit all these into a readable account is a remarkable achievement on which Dr Pyke must be warmly congratulated—and it is readable! By directing attention to the tenuosity, the artificiality, of the boundaries of each formal discipline in science and to the limitations of present-day theoretical and experimental equipment in interpreting the behaviour of very small particles and of very large molecules, the author moves from the directly seen to the indirectly felt, from the outside to the inside, from the senses to the spirit. His arguments that chemistry is physics, biology is chemistry, and physics 'the subjects with which physicists deal' (later amplified and elucidated), that 'chemistry is the science of matter and physics . . . the science of energy,' that mathematics 'represents abstract thinking at its highest level,' and very many more equally challenging statements could provide food for thought for the individual or subject-matter for discussion for groups of thoughtful people. Some statements will stimulate, others amuse, others irritate, and some may even anger the reader. One gets the impression that Dr Pyke will be perfectly happy—provided there is a response.

The *multum in parvo* philosophy behind the writing of this book clearly demanded skilful, even pungent, phraseology. This is occasionally overtaxed and the reader is jolted by an odd sentence, as on p. 47 'A catalyst is a substance that makes a chemical reaction that could happen but does not happen, happen.' Complete knowledge and understanding of each of the many topics could not be expected from the author (or the reviewer!)—some errors of fact are inevitable. But errors of phrasing may also cause the reader some concern, and a desire to 'leaven the lump' by a snappy phrase may produce the incongruous statement. Thus, on p. 36, the fallacy that atomic number is given by the number of electrons in an atom is perpetuated; on p. 45 '. . . round the nucleus of each [atom] there spins a series of concentric clouds of electrons'; on p. 38 Bohr (in 1913) used 'these ideas of quantum mechanics.' On p. 39, 'Galileo and Kepler turned the universe upside down . . . the earth went round the sun. But . . . farmers and *sun-tan-cream manufacturers still carried on their businesses much as before*' (my italics). And on p. 61, within 15 lines of print, three cognate facts are stated (again my italics) thus: '. . . ostensibly matter-of-fact elements were *played on* by a beam of α-particles'; 'When *an* α-particle is *shot into* the tightly packed nucleus . . .'; '. . . Rutherford *sprayed* nitrogen with α-particles.' Some errors might have been avoided by better proof-reading, for example 'X-rays could be defracted' (p. 36), 'absorbed' for 'adsorbed' (p. 49), 'nickle' (p. 48) and 'oxyphosphorous' (p. 22).

But the blemishes, inevitable or avoidable, do not seriously diminish the readability of the book, which can be recommended *magna cum laude*.

W. ROGIE ANGUS

Institute Affairs

THE SECRETARY AND REGISTRAR

Dr H. J. T. Ellingham, Secretary and Registrar of the Institute, will reach retiring age in November, 1962. Although almost a year hence, it is appropriate to take immediate steps towards trying to fill this, the most important, post in the Institute which he holds with such distinction. An advertisement inviting applications appears on p. xv.

NOMINATION OF GENERAL MEMBERS OF COUNCIL

In accordance with the provisions of By-Law 23 (c) the following General Members of Council are due to retire at the Annual General Meeting on 13 April, 1962, and are ineligible for re-election in that capacity or for election as District Members of Council :—

Ernest Harrison Coulson, M.SC., A.R.C.S., D.I.C.
Donald Clarence Garratt, PH.D., D.SC.
Sir Christopher Kelk Ingold, D.SC., A.R.C.S., D.I.C., F.R.S.
Henry Norman Rydon, M.SC.TECH., PH.D., D.PHIL., D.SC., A.R.C.S., D.I.C.
Charles Simons, B.SC., PH.D., A.R.C.S., D.I.C., Barrister-at-Law.
Ralph Louis Wain, PH.D., D.SC., F.R.S.
David Woodcock, PH.D., D.SC.

Seven General Members of Council are therefore to be elected at the Annual General Meeting in 1962 to fill these vacancies. The Council will in due course make nominations for this purpose under By-Law 25 (d). Other **nominations under By-Law 26** are now invited and must be delivered at the Institute **not later than 1 February, 1962.**

By-Law 26 reads :—

26 (1) Any ten corporate members, not being Members of the Council, may nominate an eligible Fellow as a candidate for election as a General Member of the Council but no corporate member shall concur in nominating more than one such Fellow at any particular election.

(2) Any nomination made under this By-Law . . . shall be in the following form :—

'We, the undersigned, being corporate members of the Royal Institute of Chemistry do hereby certify that A.B. of

(registered address), a Fellow of this Institute, is, in our estimation, a fit and proper person to be a General Member of the Council of the Institute, and we do hereby nominate him as a candidate for election as a General Member of the Council.'

(3) Any such nomination may consist of several documents in like form, each signed by one or more corporate members, and shall be accompanied by a statement by the candidate that he is willing to accept such nomination.

When considering making nominations under By-Law 26, corporate members may wish to be reminded that :—

(*a*) Nominations for District Members of Council were invited in October (*see J.*, 375), and the notice included a complete list of present District Members of Council showing which were ineligible for re-election.

(*b*) Present General Members of Council who are due to continue in that capacity after the Annual General Meeting, 1962, are :—

Until the A.G.M., 1963 : Dr H. J. Barber, Dr R. W. Bolland, Professor W. Bradley, Dr C. M. Cawley, Mr J. E. Davis, Dr C. Forrester, Professor L. Young.

Until the A.G.M., 1964 : Professor R. M. Barrer, Mr G. H. Bottomley, Dr F. Hartley, Professor E. D. Hughes, Dr D. G. O'Sullivan, Dr R. H. Purcell, Dr E. C. Wood.

(*c*) It will be for the Council to make nominations in due course under By-Law 22, to fill vacancies among Officers that will occur at the Annual General Meeting, 1962, through the retirement of the following :—

Vice-Presidents :
Harry Julius Emeléus, C.B.E., PH.D., D.SC., A.R.C.S., F.R.S.
Richard Alan Morton, PH.D., D.SC., F.R.S.
George Rowntree Ramage, PH.D., D.SC., F.S.D.C.

The following Vice-Presidents are due to continue in that office until the A.G.M., 1963 : Mr G. Dring, Dr F. A. Robinson and Mr E. J. Vaughan.

EXAMINATIONS, APRIL, 1962

Graduate Membership, Part II

The theoretical section of the examination, Part II (*a*), will be held in London and Newcastle upon Tyne and, if required, in other centres on **Monday and Tuesday, 2 and 3 April, 1962.**

Practical exercises will be carried out in London and in Newcastle upon Tyne on **Wednesday to Saturday, 4 to 7 April,** inclusive, and in London on **Tuesday to Friday, 10 to 13 April,** inclusive.

Candidates will be asked to state their preference as to the centre for their theoretical papers and the period and centre for their practical exercises, but it must be clearly understood that no guarantee can be given that their wishes will be met.

Candidates who have not yet been accepted for examination and who wish to present themselves in April should obtain from the Assistant Registrar without delay the prescribed Application Form, so as to allow ample time for obtaining the necessary signatures certifying that they have complied with the Regulations concerning their courses of training. **The completed Application Forms must reach the Institute not later**

than Wednesday, 3 January. No application will be considered if received after that date.

The last date for the receipt of Entry Forms is Monday, 5 February. No Entry will be accepted if received after that date.

EXAMINATIONS, OCTOBER, 1961

Postgraduate Diploma in Branch E: Chemistry (including Microscopy) of Food, Drugs and Water.

Examiners: Dr H. E. Archer, Mr T. McLachlan

There were four candidates, all of whom passed.

PASS LIST

BAXTER, Henry George, B.SC.(LOND.), A.R.C.S., A.R.I.C.
LATIMER, Anthony Harold, B.SC.(LOND.), A.R.I.C.
POTTER, John Anthony, A.R.I.C.
WATTS, Antony Inman Cecil, A.R.I.C.

ANNUAL SUBSCRIPTIONS, 1962

Annual subscription notices for the year 1962 will be sent to all members on or before 31 December, 1961. In order to reduce administrative costs a new office procedure for dealing with subscriptions is being introduced. Remittances should, whenever possible, be accompanied by an official payment form and members are asked to take note of the instructions on these forms.

LIFE MEMBERSHIP FEES

The following provisions under By-laws 61 and 62 took effect from 1 January, 1957.

The standard Life Membership Fee payable by a Fellow or Associate of the Institute shall be determined by the formula—

$$L = 3\,(70 - a)$$

L being the Life Membership Fee in pounds when a is the age in years on 31 December of the year preceding that in which the Fee is paid.

For Fellows and Associates who were 60 or more years of age at the aforesaid date 1/45 of the standard Life Membership Fee shall be remitted in respect of each completed year of corporate membership at that date.

On payment of a Life Membership Fee the liability of a Fellow to pay an annual subscription shall cease and the liability of an Associate to pay an annual subscription shall cease irrespective of whether he remains an Associate or subsequently becomes a Fellow; entitlement to the privileges of membership shall not be affected.

Life Membership Fees to be effective on 1 January in any year must be paid before 1 July in that year.

MELDOLA MEDAL LECTURE

Dr J. N. Bradley, Meldola Medallist for 1960, delivered his lecture on 'Shock Waves in Chemistry' on 22 November. On this occasion Dr Bradley chose the place for the lecture—the Department of Chemical Engineering and Chemical Technology, Imperial College, London, where Professor J. S. Rowlinson (Medallist for 1954) was host.

Dr S. I. Levy (representing the Society of Maccabaeans) having outlined some of the highlights and characteristics of Meldola's work, the President, Sir William Slater, K.B.E., F.R.S., congratulated Dr Bradley on his achievements (*J.*, 182) and presented the Medal.

Dr Bradley proceeded to give a very clear and succinct account of the nature of shock waves, their production in the laboratory, and their application in the solution of various chemical problems, especially in the field of gas reactions. The vote of thanks was proposed by one of his former teachers, Sir Harry Melville, K.C.B., F.R.S. (Medallist for 1935). It is proposed to include this address in the 1962 *Lecture Series*.

After the lecture the Meldola Society held its annual dinner at Brown's Hotel, Sir Cyril Hinshelwood, O.M., F.R.S. (Medallist for 1923), being Chairman on this occasion. Among those present were Sir Louis Gluckstein, Q.C., Dr S. I. Levy, Q.C., and Dr R. Lessing, C.B.E., representing the Society of Maccabaeans, and Dr D. W. Kent-Jones (Past President), whose initiative in arranging the first such dinner party led to the formation of the Society.

On this occasion some historical documents were on display. They included the notebook of Meldola's practical analytical work at the Royal College of Chemistry in 1866, some notes recording the somewhat abortive expedition to the Nicobar Islands in an attempt to photograph the total eclipse in 1875, and some notes made in the East Mersea area after the East Anglian earthquake of 1884.

The Chemical Council.—Dr F. A. Robinson has been appointed as a representative of the Institute on the Chemical Council for a period of three years beginning on 1 January, 1962, in succession to Dr C. W. Herd, who will complete his term of service in this capacity at the end of the year.

Joint Library Committee.—Mr H. W. Cremer, C.B.E., Dr J. H. Skellon and Mr E. J. Vaughan, C.B.E., have been reappointed as representatives of the Institute on the Joint Library Committee for the year beginning 1 January, 1962, and Professor Leslie Young has been appointed as the fourth representative on this Committee from that date in succession to Mr A. L. Bacharach, who has rendered valuable service in this capacity over a period of many years.

Oversea Candidates: Assessment Fees.—As a result of reviewing the provisions for assessing the merits of applicants for admission to corporate membership who have been trained in a Commonwealth or foreign

university or institute and have not passed the Graduate Membership examination, the Council has decided to require each such applicant for the Associateship (under Regulation G3), or for the Fellowship direct, to forward with his application a non-returnable assessment fee of £3 3s. Notice is given that this decision will apply to applications submitted by such candidates after 31 March, 1962.

The Council was reluctant to re-introduce an assessment fee for applicants under Regulation G3 but concluded that, as all applications from candidates trained overseas have to be specially considered on their individual merits, it was reasonable to do this and to extend the provision to such candidates who apply for direct election to the Fellowship.

Licentiateship.—Members are reminded that the revised By-laws that were approved by a Special General Meeting held on 20 July (*J.*, 336) cannot take effect until they have been allowed, with or without modification, by the Lords of Her Majesty's Most Honourable Privy Council. As these changes in By-laws have not yet been allowed, references to Licentiateship as an established grade of membership are premature. Members may be assured, however, that the Council of the Institute is making appropriate preparations for instituting the new grade as soon as possible after the Privy Council's decision has been announced.

Proposed Local Section in Nigeria.—The Council has been pleased to accept an application submitted in accordance with By-law 89 for the establishment of a Local Section of the Institute to serve the area of the Federation of Nigeria and to be known as the Nigeria Section. It was noted with particular satisfaction that the signatories of the application included a large proportion of the corporate members resident in Nigeria, and were representative of the various fields of occupation in the principal centres of professional activity. It was agreed that the formation of a Local Section in Nigeria should do much to further the work of the Institute and the interests of corporate members in the Federation. The opportunity is being taken of discussing with Mr A. S. Cook, *Fellow*, who formally submitted the application and is at present in this country, the further steps that need to be taken to inaugurate the new Local Section, so that the necessary arrangements may be made early next year. In the meantime all members resident in Nigeria have been notified individually that the project is in hand, and the good wishes of the Council for its success have been conveyed to them.

Geographical Index to the Register.—At their meeting on 20 October the Council took note of doubts that had been expressed by the Finance and House Committee as to the extent to which the usefulness of the Geographical Index to the *Register of Fellows and Associates* justified the expense of producing it in its present form. The cost of printing the Index amounts to some £500, quite apart from expenditure on the preparative work involved. It was recalled that the Geographical Index was formerly published as part of the *Register*, but that this practice was dropped some years ago because it led to an inordinate delay in the publication of the *Register*. Latterly the Index has been prepared as a separate publication available on request to those who had already ordered a copy of the *Register*. It has always been recognized, however, that for oversea members a Geographical Index was of particular value, and all such members automatically receive a copy of each edition of the *Register* and of the Geographical Index in its present form. In Great Britain and Ireland, however, Local Sections are provided with card indexes of their members, which are kept up to date, and the address plates are sectionalized so that each Section can communicate readily with its own members through the office and, of course, do so in issuing notices of meetings and other Section material. It has been suggested that this service may be regarded as adequate for home members, and that a considerable saving of time and money might be effected by restricting the Geographical Index to places outside Great Britain and Ireland and by publishing this as a part of each future edition of the *Register*. It was agreed that further consideration be given to this proposal before arrangements are made for preparing the next edition of the *Register*, which is expected to be as at 31 October, 1962.

Directory of Independent Consultants.—A press conference was held in the Institute on 16 October to launch the new edition of the *Directory* (cf. *J.*, 375). Representatives of the press who attended were addressed by the President, Sir William Slater, and received advance copies of the *Directory* with a press notice that was sent immediately afterwards to editors of periodicals not represented at the conference. Since then, notices of the publication of this fourth edition of the *Directory*, indicating its availability without charge to *bona fide* inquirers for consultant services, have appeared in numerous organs of the technical press and in such papers as *The Financial Times*. As a direct result of this publicity some 400 copies of the *Directory* have already been issued to inquirers, and altogether around 2,000 copies have been distributed to organizations and individuals likely to be interested in placing inquiries for consultant services in chemistry and closely related subjects.

In the preparation of this new and improved edition of the Institute's *Directory*, the Council was glad to have the advice of representatives of the Association of Consulting Scientists, provided through a Joint Committee of the two bodies. The Hon. Secretary of the Association, Mr W. H. Stevens, *Fellow*, has written to express the thanks of his Council to the Officers and

Council of the Institute for allowing them to co-operate in the development of the revised *Directory*, and for the considerable effort put into arrangements for the press meeting to launch it.

Professor H. T. S. Britton.—To commemorate the life and work of the late Emeritus Professor Britton, who was very largely responsible for the inauguration of the South-Western Counties Sections of the Royal Institute of Chemistry and the Society of Chemical Industry, an *ad hoc* Committee, representing these bodies and the Chemical Society, has been authorized to establish a 'Britton Memorial Lecture.'

Having due regard to Professor Britton's interest in young people and in physical chemistry and forensic science, the Committee aims to select, from people working in or who have worked in the Section Area, and at such intervals as funds permit, a lecturer under 30 years of age primarily interested in these branches of chemistry.

A personal 'appeal for funds' will be addressed shortly to members of the local sections but it is felt that many chemists formerly resident in the South-West, and others who were his friends, may wish to be associated with the proposal.

All donations should be made payable to the 'Britton Memorial Fund' and sent to the Honorary Treasurer, Dr S. J. Gregg, Chemistry Department, Washington Singer Laboratories, University of Exeter, Prince of Wales Road, Exeter.

Chemical Society Library. In accordance with a decision of the Joint Library Committee, the Library opening hours will be changed from Monday, 1 January, 1962. From that date the Library will be open from 9.30 a.m. to 6 p.m. (Saturdays 5 p.m.), except for Thursdays, when it will remain open until 9 p.m. It is hoped that the new arrangements will meet the requirements of readers wishing to carry out a lengthy literature search, whilst allowing for better deployment of staff.

PERSONAL NOTES

News of Hon. Fellow

Sir Henry Dale, O.M., G.B.E., F.R.S., *Nobel Laureate*, had the degree of Doctor of Science *honoris causa* of the University of Leeds conferred on him when he visited Leeds on 7 November to open the Wellcome Building at Leeds General Infirmary.

Societies and Institutions

Mr G. Ingram, *Associate*, was awarded honorary membership of the Metropolitan Microchemical Society at the International Symposium on Microchemical Techniques held in Pennsylvania State University, U.S.A., earlier this year.

Royal Society of Edinburgh.—At the annual statutory meeting, the following *Fellows* were elected to the positions indicated for 1961–62: President, Professor E. L. Hirst, C.B.E., F.R.S.; Secretary to Ordinary Meetings, Dr M. Ritchie; Members of Council, Drs M. A. Pyke and A. B. Stewart.

Educational

Dr E. G. Cowley, *Fellow*, head of the chemistry department at Brighton Technical College, has been appointed principal of Swansea College of Technology.

Professor K. G. Denbigh, F.R.S.E., *Fellow*, Professor of Chemical Engineering Science, Imperial College of Science and Technology, has been appointed to the Courtaulds Chair of Chemical Engineering tenable at that college.

Dr J. Magee, *Associate*, has been appointed senior lecturer in physical chemistry, Whitehaven College of Further Education, as from 1 January, 1962.

Dr L. N. Owen, *Fellow*, has had the title of Professor of Organic Chemistry in the University of London conferred on him in respect of his post at the Imperial College of Science and Technology.

Dr T. P. Jones, *Associate*, has returned to this country from Canada, where he was at the University of Alberta, and is now a senior research fellow at the Royal Military College of Science, Shrivenham.

Dr R. S. Ramakrishna, *Associate*, hopes to return to Ceylon shortly to resume his duties as lecturer in the department of chemistry, University of Ceylon. He is at present a postdoctorate fellow in the department of inorganic and structural chemistry, University of Leeds, having completed his studies at the University of Oxford.

Professor R. L. Wain, F.R.S., *Fellow*, has been appointed a member of a three-man mission to visit Jordan to advise on the setting up of a university in that country.

Dr D. S. Weir, *Associate*, formerly of the department of chemistry, University of Rochester, U.S.A., is now at the department of chemistry, Queen's College, Dundee.

Mr C. S. Wong, *Associate*, has been appointed assistant lecturer in chemistry, United College of Hong Kong, and is at present also serving as acting head of the department of chemistry.

Commonwealth Education Conference.—Dr J. W. Cook, F.R.S., *Past President*, and Dr G. E. Watts, *Fellow*, have been appointed members of the delegation to the Commonwealth Education Conference at New Delhi. The delegation will be led by Sir David Eccles, Minister of Education.

Public and Industrial

Dr V. Armstrong, *Fellow*, has been appointed chairman of the Commonwealth Agricultural Bureaux for 1961–62.

Mr R. E. Ansell, *Associate*, has been appointed sales director, Henry Wiggin & Co. Ltd, as from 1 November.

Dr A. W. Baldwin, *Associate*, has been co-opted as a governor of the J. A. Radley Research Institute.

Mr Barrie L. Davies, *Associate*, formerly an assistant experimental officer at the Research Station, Long Ashton, is now a technical officer in the new polymers group, British Nylon Spinners Ltd, Pontypool.

Mr C. L. Evans, *Fellow*, has relinquished his position as a managing director of Associated Chemical Cos (Brotherton) Ltd on his appointment as managing director, production and technical, of Associated Chemical Cos (Fertilisers) Ltd.

Mr V. F. F. Henley, *Fellow*, until recently with W. Canning & Co. Ltd. and formerly a director of Alumite & Alzak Ltd., has been appointed a director of Mitro Anodising Ltd, London.

Mr J. T. Hill, *Associate*, has left this country for Turkey, where he expects to remain for a few months. His address will be c/o B.P. Overseas Refining Co. Ltd, P.K. 291, Sisli, Istanbul.

Mr R. Holden, *Associate*, has taken up a post as a process engineer at the Fawley Refinery of Esso Petroleum Co. Ltd.

Mr D. P. Hopkins, *Fellow*, has been appointed chairman of H. & T. Proctor Ltd, fertilizer manufacturers, Bristol.

Dr D. Jack, *Fellow*, has been appointed director of research, Allen & Hanburys Ltd.

Dr J. T. Kendall, F.R.S.E., *Associate*, has been appointed managing director of Microwave & Semiconductor Devices Ltd.

Dr J. McDougall, *Associate*, formerly with the Distillers Co. Ltd, Epsom, has joined the English Grains Co. Ltd, Burton-on-Trent, as senior microbiologist.

Dr W. R. McLean, *Associate*, formerly with Laporte Chemicals Ltd, Luton, is now a technical officer, Imperial Chemical Industries Ltd, Heavy Organic Chemicals Division.

Mr J. B. Maylor, *Associate*, formerly a technical officer with Imperial Chemical Industries Ltd, Metals Division, is now corrosion chemist, technical service section, Henry Wiggin & Co. Ltd, Hereford.

Dr A. L. Misra, *Associate*, has accepted a position in the galenic research group of Ciba Ltd, Basle. He was formerly at the Central Drug Research Institute, Lucknow, India.

Mr J. J. O'Leary, *Fellow*, head brewer of Beamish & Crawford Ltd, Cork, has been co-opted to the board of the company.

Mr G. E. J. Reynolds, *Fellow*, has been appointed research manager, Vinyl Products Ltd. He has been assistant research manager since 1957.

Dr I. A. Simpson, *Fellow*, formerly senior nutrition officer, Institute for Medical Research, Kuala Lumpur, Malaya, has taken up an appointment as nutrition officer, Food and Agriculture Organisation, for Asia and the Far East (Western Zone), New Delhi.

Sir William Slater, K.B.E., F.R.S., *President*, has recently attended the U.N.O. Committee in New York which is planning the conference on the application of science and technology in underdeveloped areas to be held in Geneva in August, 1962.

Mr V. K. I. Subramanian, *Associate*, is now general manager, Ashok Paper Mills Ltd, Calcutta, India.

Mr A. M. Swartz, *Associate*, has recently been appointed technical adviser (quality) to the managing director of White's (South African) Portland Cement Co. Ltd, Johannesburg. He retains his position as chief chemist and deputy works superintendent, Salisbury Portland Cement Co. Ltd, Southern Rhodesia.

Mr L. A. Telesz, *Associate*, has joined the Elton Cop Dyeing Co. Ltd, Bury, as technical director.

Mr C. N. Thompson, *Associate*, has been appointed a director of Shell Research Ltd, and, with effect from 1 November, manager of the company's London office.

Dr A. Walton, *Fellow*, has been appointed Mossend works manager, Imperial Chemical Industries Ltd, Billingham Division. He was formerly deputy works manager.

Mr J. P. Wapenaar, *Associate*, has been appointed technical liaison officer for African Explosives & Chemical Industries Ltd at the head office of Imperial Chemical Industries Ltd in London.

Mr A. G. Wilkie, *Associate*, formerly works manager, Winn & Coales Ltd, is now a member of the chemical branch of the factory inspectorate, Ministry of Labour.

Dr Tegwyn P. Williams, *Associate*, formerly at the University College of North Wales, Bangor, is now a research chemist at the Unilever Research Laboratory, Colworth House, near Bedford.

Mr J. M. Woodcock, *Associate*, resigned his post of formulation chemist, British Schering Ltd, last April to take up the appointment of development chemist, C. M. W. Laboratories Ltd, Blackpool.

Retirements

Dr H. H. Barber, *Fellow*, retired from the lectureship in pharmacology, University of Nottingham, on 31 August.

Mr P. C. Chaumeton, *Fellow*, deputy chairman of Erinoid Ltd, retired on 1 November after 45 years in the plastics and textile industries. He joined Erinoid in 1944 and was appointed deputy chairman in 1959.

Dr A. B. Crawford, *Fellow*, has retired from his post as principal lecturer in chemistry, the Royal College of Science and Technology, Glasgow, after 40 years' service.

Dr J. Ferguson, *Fellow*, research and development director, is to retire from the main board of Imperial Chemical Industries Ltd on 30 November, after 33 years' service with the company.

Dr N. H. Hartshorne, *Fellow*, retired from his position of reader in chemical microscopy, school of chemistry, University of Leeds, at the end of September.

Mr C. E. Mold, *Associate*, retired from the position of director and manager of Price's Patent Candle Co. Ltd on 30 September.

Section Activities

Aberdeen and North of Scotland

Gas Chromatography. The first meeting of the session was held on 18 October in Marischal College. Professor W. O. Kermack, F.R.S.E., F.R.S., was in the Chair. Dr A. T. James lectured on 'Recent advances in gas chromatography and its applications to biochemistry.' Dr James began by describing some new detection devices for use in gas chromatography, and showed slides of the flame ionization detector and three types of argon detector. These devices greatly increase the sensitivity of detection and allow the load on the chromatogram to be decreased from mg to μg amounts. This in turn was shown to lead to a decrease in the amount of stationary phase needed, making for quicker running and greater efficiency in the chromatogram. A longer column could be used to increase efficiency but this leads to difficulties owing to the pressure needed to force the gas through the column. Ways of overcoming this difficulty were discussed; the greatest advance has been the introduction of the capillary column. The general arrangement of a capillary column apparatus was shown, and the use of this type of column in the automatic monitoring of oil-well drilling mentioned. On the biochemical side, the new rapid columns have allowed the separation of such substances as the acetates of sterols, alkaloids and the esters of bile acids. The running of a substance on two types of chromatogram as an aid to identification was illustrated by some experiments on human faecal fatty acids. Methods of measuring the radioactivity of fractions from the chromatogram were dealt with, and a counter devised by the lecturer was shown. Examples of the use of this device in investigations of the biosynthesis of higher fatty acids carried out by the lecturer were discussed and illustrated. The vote of thanks was proposed by Dr R. L. M. Synge, F.R.S.

Discovery of New Drugs. On 9 November Dr A. F. Crowther gave a talk on 'The discovery of new drugs.' In his lecture, he said that the research chemist in the pharmaceutical industry attacks the problems of discovery of new drugs in many ways that do not differ in principle from those adopted by his colleagues in other branches of speculative applied organic chemical research. Thus, for example, modifications in the structure of known drugs and application of fundamental physiological chemistry have led to important advances in several fields of therapy. The values of the various approaches may be illustrated by many examples of drugs discovered in recent years which are useful in the treatment of, for instance, mental diseases and bacterial and protozoal infections.

The problems of the medicinal chemist are unique in the sense that the requirements for a successful drug are necessarily much more stringent than for other products of the chemical industry. Above all other obstacles, the hurdle of possible toxic side-effects creates most difficulties. Process development and production in bulk of new drugs are approximately in line with those of other organic chemicals, particularly dyestuffs. The main difference lies in the care that must be taken to ensure the purity of the final product.

After discussion the meeting closed with the vote of thanks to Dr Crowther proposed by Dr June Olley.

Belfast and District

Rumen Metabolism. On 16 November Professor J. Houston gave a lecture entitled 'Chemistry and the Cow.' Dr R. J. Magee presided at the meeting, which was held at Queen's University.

The lecturer began by commenting that, although the cow was a relatively poor converter of vegetable matter into foodstuffs for human beings, milk production occupied a very important place in the economy of Northern Ireland. The ability to digest large amounts of cellulose and other polysaccharides was the outstanding characteristic that distinguished the cow from simple-stomached animals. This digestion was brought about by symbiotic micro-organisms in the rumen.

The investigations of the chemical reactions taking place in the rumen by experiments on fistulated animals and artificial rumens were explained, and the effect of the feeding of concentrates on cellulose digestibility was discussed. Several other aspects of ruminant digestion were also discussed from the chemical point of view. These included the adverse effect of the grinding of hay on butterfat percentage and the effect of high-energy diets on the solids content (not including fat) of milk. Recent research work on the relative proportions of volatile fatty acids produced under different feeding regimes was mentioned.

Professor Houston also dealt with the fermentation of proteins and lipids in the rumen, and underlined the importance of micro-organisms in building up, for the use of the cow, proteins of high biological value when low-grade proteins were fed. Mineral metabolism in the rumen was dealt with in relation to hypomagnesaemia.

The lecture was followed by the showing of a coloured film entitled 'The Rumen Story.' This film depicted in a most interesting manner certain physiological aspects of ruminant digestion, and was greatly appreciated.

After questions, the vote of thanks to the speaker was proposed by Professor C. L. Wilson.

Birmingham and Midlands

Social Activities. The Annual Dinner and Dance was held at the George Hotel, Solihull, on 29 September, and about 100 members, their wives and friends were present. The Social Secretary felt that this was a

disappointing number in view of the attendance at the two previous functions held at the George Hotel.

The Section also participated in an informal presentation dinner to Mr Sydney Marks, arranged by members of the chemistry department of the College of Advanced Technology and other interested groups in Birmingham, to mark his retirement after many years as deputy head of the chemistry department.

Research Work in Budapest. The first meeting of the 1961–62 programme was a joint meeting with the Midlands Section of the Society for Analytical Chemistry, held on 10 October at the University, Edgbaston. In welcoming Professor Laslo Erdey, of the Technical University, Budapest, the Chairman, Mr George King, thanked him for accepting the invitation to lecture in Birmingham during the period of his study leave in Belfast. In an extremely informative lecture Professor Erdey detailed the various investigations in the field of analytical chemistry which he and his collaborators had successfully completed or were still undertaking at the Technical University. Emphasis was placed on studies of the redox indicators 4-amino-4-methoxydiphenylamine (Variamine Blue B) and its derivatives, and the chemiluminescent indicators, luminol, lucigenin and lophine. The applications of these indicator systems to classical titrimetric analysis were described. A new approach to thermogravimetric analysis, through the introduction of a derivative thermogravimetric balance (derivatography), had permitted a more quantitative approach to thermogravimetry to be developed.

In thanking Professor Erdey for his lecture, Dr H. C. Smith, Chairman of the Midlands Section, S.A.C., paid tribute to the high quality of work carried out at the Technical University.

Zone Refining. A meeting of the Section was held at the College of Technology, Northampton, on 11 October, with Mr King again in the Chair.

Dr E. F. G. Hetherington of the National Chemical Laboratory, Teddington, spoke on 'Zone Refining.' The theory of zone refining was outlined, and the behaviour of different types of mixture was discussed. The effect of varying the zone length was considered, and a simple method for computing the expected degree of purification was presented. Speeds suitable for zone movement were suggested, and photographs and drawings of apparatus for treating metals, inorganic and organic compounds were shown. A simple zone-refining apparatus was described; this can be made at little cost and can be used to illustrate the principles of the technique through the study of a mixture of a dye (*e.g.* methyl red) with naphthalene.

Some methods for establishing the purity of zone-refined materials were discussed. Finally, the use of zone refining for removal of salts from water, the separation of isotopes and the fractionation of polymers were mentioned.

There was a large attendance, and a lively discussion followed the lecture. The vote of thanks to the lecturer was proposed by Dr W. Siddall.

Overcrowded Molecules. A meeting of the Section was held at the College of Advanced Technology, Gosta Green, on 26 October, when Professor C. A. Coulson, F.R.S., of the University of Oxford, delivered a lecture entitled 'Overcrowded Molecules.' Mr King was in the Chair.

In his extremely lucid and informative lecture, Professor Coulson outlined how a study of molecular crystals had shown that under normal circumstances atoms in different molecules did not approach nearer than fairly well-defined distances. From a comparison of these a set of van der Waals radii could be established. But there were many interesting molecules which, for internal geometrical reasons, had some of their non-bonded atoms closer together than the sum of the van der Waals radii. These 'overcrowded molecules' might bend, or twist, or corrugate, depending on the circumstances. In every case a compromise was necessary between valence forces trying to force one set of bond angles and lengths and steric forces trying to establish another. Professor Coulson indicated how an appreciation of these phenomena had led to interesting applications in ultra-violet spectra and in certain types of reactivity, particularly for large polynuclear hydrocarbons.

The large and appreciative audience made full use of the time available for discussion, and Dr. W. G. S. Parker proposed the vote of thanks.

BRISTOL AND DISTRICT

Solid-Propellent Rockets. At a meeting held at Bridgwater on 12 October, Dr G. S. Young lectured on this topic. He said that a rocket is a device which propels itself by ejection of a portion of its own mass. The energy for this is normally provided by a chemical reaction, which can be achieved in either the liquid or solid states. This energy is shown as an increase in enthalpy (total heat), and is converted isentropically to kinetic energy in the exhaust gases.

These principles were not understood until comparatively recently, but rockets have been used since the thirteenth century. In the eighteenth century they were used by the Hindus against the British, and subsequently Sir William Congreve developed some incendiary rockets which were used with fair success in the later stages of the Napoleonic Wars and in the war of 1812. After this, interest gradually declined, because of the improvements in guns, and little further work was done until just before World War II.

Dr Young confined his lecture to a consideration of solid propellents. The solid propellent used in the early rockets was gunpowder, but this was replaced, in World War II, by types of cordites. Since that date

many new propellents have emerged, and at present they are divided into two main classes, double base and composite. The lecturer then described these classes, and went on to discuss the distinction between a high explosive and a 'low' explosive (or propellent), together with the typical ingredients used. The normal mode of burning is usually termed 'deflagration,' implying a steady burning at an exposed surface in a layer-to-layer fashion at a predictable rate. The rates of burning available and the various methods of determination were then dealt with.

The physical properties of the main types of solid propellent control their practical utilization. Extruded, or pressed, charges are used for the smaller rockets, whereas cast propellents are used for the larger types. The special properties of the British plastic, or putty-like, propellent were mentioned.

Reference was also made to the most recent type of cast propellent, based on a rubbery binder of the polyurethane type. In this case, a slurry mix is poured into the rocket motor and is cured, *in situ*, to form a rubbery material rather like a motor-car tyre.

Methods of quality control were briefly discussed. Some current problems in this field relate to the increasing energy and size of the rockets.

Nozzle materials are of crucial importance. Graphite, tungsten, molybdenum or various carbides are all in vogue, and present particular problems of manufacture.

In the design of rocket motor tubes, special high tensile steels are used, and these present a fabrication problem, particularly in regard to welding, where the argon-arc technique is extensively employed. Rocket motors have also been made by wrapping up steel strip and sticking it with epoxide resins. Cases from woven glass fibre have also been made, and present problems of attachments of end closures and storage stability. Other difficult practical problems, especially with large rockets, relate to methods of ignition and instability of combustion.

Future prospects depend on the use of so-called 'exotic' materials, such as nitronium perchlorate. Some of the practical difficulties involved in this work were mentioned.

CARDIFF AND DISTRICT

Annual Dinner and Dance. The Eleventh Joint Annual Dinner and Dance of the Section and the South Wales Section of the Society of Chemical Industry was held at the Monkstone Club, Cardiff, on 20 October. Members and their guests were welcomed by the two chairmen, Mr J. R. Millar (S.C.I.) and Mr J. S. Hughes (R.I.C.)

The Loyal Toast and, later, a toast to the joint societies were proposed by the officiating chairman, Mr Millar. These were the only formal speeches. Afterwards dancing continued until 1 a.m., and the evening was a great success.

Mr and Mrs J. S. Hughes (*right*) with Mr and Mrs J. R. Millar

DUNDEE AND DISTRICT

Police Surgeon's Work. The opening meeting of the session was held on 20 October at the Technical College, Dundee, when Dr W. Fyffe Dorward, Police Surgeon for the City of Dundee, spoke on 'Science and the Police Surgeon.' Dr D. G. Neilson presided.

Dr Dorward described the duties of a police surgeon and listed the major items that were his concern, including the most important task of teaching medical students how the law affects medical personnel in their work.

In recent years there have been more sudden, unexplained deaths than perhaps most of us appreciate. Road accidents and sexual crimes have been on the increase; so also has the particularly vicious form of attack, kicking. The speaker pointed out that this greatly added to a police surgeon's work, and has entailed a greater need for chemical and scientific expert help. Sir Bernard Spilsbury was one of the first to enter this field, with his use of the microscope during the Crippen case, when he detected abdominal scar tissue indicative of appendicectomy. Belle Elmore, Crippen's victim, was known to have had such an operation, which was rare at the time.

In centres such as Glasgow and Edinburgh, university laboratories were utilized for this early scientific approach. New Scotland Yard was the first independent laboratory to be set up having an interest in forensic science, and here, incidentally, were the pioneers in the science of fingerprinting. Following this trend towards specialization, Dr Helpern (U.S.A.) last year built a £1 million Forensic Science Unit in New York, and this year the University of Cambridge opened a separate department of forensic science (criminology).

The first full-scale co-operation between the police and scientists took place during the Ruxton case. Ruxton, being a doctor with knowledge of forensic science, removed all identification marks from his victims. Those concerned with the conviction of the accused were specialists in anatomy, pathology, zoology, radiology,

photography, dentistry, serology, shoemaking, printing, forensic psychiatry and fingerprint detection.

A local example of team-work was cited where a young girl had been smothered with a coat and assaulted. The coat was recovered from the accused, and on examination peculiar lipstick marks were found—pairs of one inch smears, some close together, others further apart. It was proved that these were due to the victim having the coat pressed on to her face both when shouting and when her mouth was closed.

In conclusion Dr Dorward quoted a passage from Taylor's *Textbook of Forensic Medicine:* 'The assistance of the chemist, the physicist, the biologist and of experts in other branches of science, has given greater precision in our work with a corresponding increase in the value of evidence. Over all, however, there must be someone who is able to advise on the procedure to be adopted, the particular scientist whose help should be sought, and who takes a final responsibility of advising the Crown.' This role can well be filled by a keen police surgeon.

After a most interesting discussion, Mr J. Wylie proposed the vote of thanks.

Annual Ladies' Evening. This meeting was held on 17 November at the Royal British Hotel, Dundee, when Mr D. M. Bryce, of Boots Pure Drug Co. Ltd, gave a lecture entitled 'Cosmetics'.

Mr Bryce began his lecture by tracing the history of the science of cosmetics, and illustrated by means of slides and a coloured drawing that the art of makeup had not changed to any great extent since the days of Cleopatra. He then explained the anatomy and physiology of the skin, and mentioned that it was, by weight, one of the largest organs of the body.

The speaker described the organization and function of his company's cosmetics development department at Nottingham, and explained the methods by which its products and containers are controlled and tested before issue to the public.

After a lively discussion the vote of thanks was proposed by Mr J. Smart.

East Anglia

Annual General Meeting. The A.G.M. was held in Ipswich on 24 October. The Section was pleased to welcome Dr F. A. Robinson, Chairman of the Publications Committee.

The Officers elected were: Chairman, Mr H. F. Bamford; Hon. Secretary, Mr R. J. Nunn; Hon. Treasurer, Dr F. C. Lloyd. Dr S. H. Pinner and Mr S. J. Porter were elected Members of Committee.

Dr Robinson then gave a talk entitled 'The *Journal* and other Institute Publications.' A concise account was given of the various publishing activities undertaken by the Institute. The talk was followed by a lively discussion, during which a number of speakers expressed their views on the content of the *Journal.* The vote of thanks was expressed by Dr S. H. Edgar.

East Midlands

Papermill and Chemical Plant Effluents. On 28 September Mr T. Waldmeyer, water and effluent chemical engineer, Reed Paper Group, gave a lecture entitled 'Treatment of Papermill and Chemical Plant Effluents.' Mr E. R. Pike was in the Chair, and the meeting was held in the new buildings of the Derby and District College of Technology.

The lecturer indicated in a lucid manner that the treatment of effluents is not only chemically difficult, but is a major social problem also. When siting a new industry it is essential to consider both the availability of water supplies and the facilities available for the treatment and disposal of trade effluent. He illustrated the problems involved by reference to different types of plant, and emphasized the particular problems of paper mills, where 20,000 gallons of water are required for the production of one ton of paper. Possible sources of water mentioned were a tidal river—which introduces problems of the presence of salt—stream water and bore holes. A typical paper mill uses four million gallons of water from bore-holes and 12 million gallons from the river daily. Hence, it is essential to conserve water and, if possible, to re-cycle it, thus saving alum. A large amount of fine pulp and china clay is recovered from the waste water. Waste solids are extracted by pumping the effluent into ash beds, and when dry removing it to be disposed of in a disused coal mine.

In paper mills where waste paper is used as the starting material, glue, ink and so on must first be removed from the fibre. The sludge of paper is stored in lagoons and air is blown through the sludge to facilitate biological decomposition by ciliates and other protozoa. However, smell is a problem.

Treatment of chemical waste presents specific problems. Mr Waldmeyer illustrated this by reference to the discharge of formaldehyde waste, which is first stored in lagoons to annul changes in the composition of the effluent, and then biological filtration and bacterial purification take place. The effluent from a glue factory is mixed with domestic sewage, diluted with water and purified by fermentation. Dinitro-*o*-cresol was cited as an example of a complex compound which cannot be removed by biological treatment but must be adsorbed on activated charcoal. The adsorbent is regenerated by heating. The remaining effluent is then treated in settling tanks and passed to biological filters.

Finally, the lecturer drew particular attention to the possibility of underground pollution if trade effluents were merely disposed of by pouring them into disused mines, as the filtration by the earth layers may not be sufficient to prevent contamination of the natural water levels which are the source of water from bore holes.

The vote of thanks was proposed by Dr T. A. Elliott.

EDINBURGH AND EAST OF SCOTLAND

Blood Group Substances. On 12 October, the opening meeting of the new session was addressed by Professor W. T. J. Morgan, F.R.S., who delivered a lecture entitled 'Some Observations on the Chemistry of Human Blood-Group Substances.'

After a brief historical introduction, Professor Morgan traced the developments which had taken place in the field of human blood-group substances. Initially the main problem was one of supply : the substances located on the red cell surface, and which determined the blood group, were also found in the salivary and gastric secretions but only in very small amounts. With the discovery, in 1943, that ovarian cyst fluid was very rich in the blood-group substances, sufficient material became available for a systematic study of their structure to be initiated.

Professor Morgan outlined the method of extracting the substances from the dried cyst fluid. They were found to be glycoproteins or mucopolysaccharides of high molecular weight, and their degradation into sugars and amino acids indicated that there was little difference between them, either qualitatively or quantitatively. Nevertheless these materials were very different from the serological point of view. It appeared therefore that ordinary chemical methods of analysis were too severe to yield much useful information. Professor Morgan then described some of the immunological methods which had been employed in work on the elucidation of the molecular structures of the mucopolysaccharides. In particular he mentioned the agglutination inhibition and the enzyme decomposition tests that had been used to determine the components of the various substances that appeared to play a prominent part in their serological reactions. Such tests showed that, with each of the A, B and O groups, a simple sugar was a component of the corresponding mucopolysaccharide which seemed largely responsible for the serological specificity of the substance. Thus with group A (A-substance) the sugar was found to be α-*N*-acetylgalactosamine, with group B (B-substance), α-D-galactose and with group O (H-substance), α-L-fucose.

After enlarging upon this method of approach to the problem, with particular reference to the work on Le^a-substance, Professor Morgan concluded his lecture by describing an apparatus which had been developed and employed in recent years for the controlled fragmentation of the mucopolysaccharides. After a lively discussion which followed, Dr G. O. Aspinall proposed the vote of thanks to Professor Morgan.

HUDDERSFIELD

Some Aspects of Management Selection. A joint meeting with the Huddersfield Section of the Society of Dyers and Colourists was held in Whiteley's Restaurant on 17 October. The Chair was taken by Mr G. Kendall, local chairman of the Society. Mr P. Hook, of Management Selection Ltd, gave a talk entitled 'Some Aspects of Management Selection.'

Selection consultancy is a comparatively recent development, but the number of appointments carrying a salary of over £1,000 a year advertised by such consultants has increased by about 50 per cent a year during the last three years, and now amounts to about 10 per cent of all appointments advertised at this level.

Consultants have a contribution to make to both clients and candidates. To clients they offer a service as full-time specialists and can often succeed in securing an appointment where the client has failed; they can give general advice on salaries, etc., as well as assessing skills, and save the client time and money. They can assure candidates their applications will be handled in complete confidence and impartially assessed.

A consultant's approach to a selection problem entails an analysis of the job, the preparation of a job specification, the obtaining of candidates, assessments and eliminations, and the submission of a short-list and advice on making the appointment. The initial analysis includes a visit to the client company and an examination of all factors connected with the job. A job description is prepared, and a specification of the type of candidate to fit it. Selection consists essentially of matching the two. The vacancy is advertised, the aim being to present the facts clearly and concisely. Assessments and eliminations are made in three stages—from candidates' initial letters of application, from the more detailed information obtained from those whom it appears appropriate to follow up, and after interview. A short-list is submitted and discussed with the client, to enable him to make the final selection.

Dr R. R. Pritchard, Section Chairman, proposed the vote of thanks to the speaker.

HULL AND DISTRICT

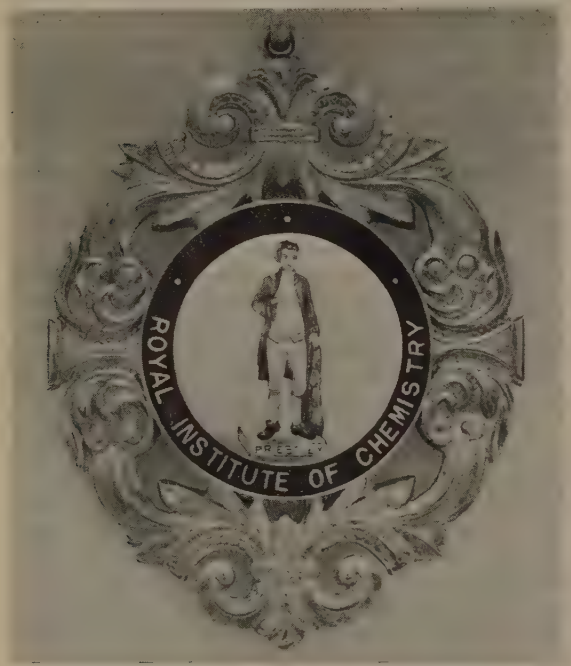
Sherry Tasting. On 26 October a Sherry Tasting was held at the Royal Station Hotel in Hull. The meeting was to have been addressed by Mr J. Laycock, of John Harvey & Sons Ltd, but Mr T. M. Rankin deputized for him at short notice.

The evening began with a brief talk on the production and types of sherry. This was followed by an excellent film on this subject loaned by John Harvey & Sons Ltd. Meanwhile the tasting took place. The meeting was very well attended by members and their wives, and proved to be a success from both an educational and a social point of view.

Thanks were expressed to John Harvey & Sons Ltd for kindly providing the samples for tasting, and to Mr Rankin for so ably filling the breach as lecturer.

Insignia of Office. The Section Chairman frequently represents the Section at functions organized by other

professional bodies in the area. It was felt by the Local Section Committee that it would lend dignity to the status of Chairman if an Insignia of Office could be worn. Several designs were considered, and it was eventually decided to use the figure of Priestley as a central motif, surrounded by a scroll design. The Insignia is of silver gilt material and the central figure



is hand-painted in enamel. The Insignia was purchased entirely by voluntary contributions of Section members.

LEEDS AREA

Annual General Meeting. The A.G.M. was held at the University of Leeds on 13 November. The Section was pleased to welcome the President as its guest of honour, particularly as he was thus able to present a cheque, on behalf of the Section, to Mr W. A. Wightman, who, after 24 years as Hon. Secretary and Treasurer, had announced his resignation, in view of his impending retirement from full-time academic life. Both the President and the Section Chairman, Dr D. McNeil, paid tribute to the devoted and loyal work that Mr Wightman had done for the Institute during his term of office, and they added their sincere wishes that Mr Wightman would enjoy a long and happy retirement. These sentiments were echoed enthusiastically by all present. In reply, Mr Wightman said that he was deeply moved by the generous action of the Section as expressed both in words and in deed, and he thanked his many friends for the gift, which he intended to use for the purchase of a television set.

By courtesy of the Yorkshire Conservative Newspaper Co. Ltd.

Mr Wightman (*left*) being presented with his cheque by the President. Dr McNeil is in the centre

During the meeting, the President greeted new Fellows and Associates. Dr McNeil was re-elected Chairman for a further year, and Mr G. J. Weston was elected Hon. Secretary and Treasurer. New Members of Committee are Professor H. M. N. H. Irving, Drs A. F. Adamson and R. P. Harker, and Messrs E. Coates and A. F. Thomson.

Science in the Underdeveloped Countries. At the Open Meeting following the A.G.M., the President delivered a lecture on 'Science in the Underdeveloped Countries' to a large and appreciative audience. He said the underdeveloped countries see the prosperity of the older and wealthier countries resting on their industries and attempt to improve their own lot by developing industry rather than by transforming their peasant agriculture and developing their natural resources. It is too often forgotten that the industries of the older countries have stemmed from the development of their natural resources, and that the skills on which industry is based were born and fostered to make use of the natural resources of the nation.

Forgetful of this, the underdeveloped countries often try to move from peasant agriculture to advanced technology at the same rate as they advance politically. This presents an impossible speed of development.

Science has followed the same path. The laboratories in the underdeveloped countries tend to be copies of those in the older and wealthier, where research is directed to serve complex industry and advanced agriculture. The problems studied are as a result often far removed from the simple scientific needs of a country in the early stages of development. There is prestige to be gained from the possession of the latest and most expensive piece of laboratory equipment and a feeling of achievement in the claim that the most sophisticated and fundamental studies are being undertaken.

In most of the underdeveloped countries the overriding need is for the improvement of agriculture and

of storing and handling food in order to lift the nutritional standards of the people. The next most important step is to build industries on the natural resources of the country, where there is a reasonable chance either of home consumption or of sales in the world markets.

It is to the solution of these problems that the scientist must put his training and his skill. Such problems call for the most part for only simple equipment, but they demand a high level of scientific knowledge and the type of mental ability which can design and execute experiments at once simple and elegant, directed to a specific end. For many such experiments the scientist will need to go out of his laboratory into the field.

The older countries have a responsibility to help to train such men (*see* also p. 429), rather than to produce narrow specialists, who can only extend in their own countries work which is being well done elsewhere and which will be freely published and made available to all.

After an interesting discussion, the Chairman proposed the vote of thanks.

LIVERPOOL AND NORTH-WESTERN

Chairman's Address. The first meeting of the Session was held on 5 October at the University of Liverpool, when the retiring Chairman, Mr E. Myer, introduced his successor, Mr G. H. Turner, Principal Assistant Analyst and Deputy Public Analyst in the Liverpool City Analyst's Department, who addressed the gathering on 'Modern Food Legislation.'

Mr Turner traced the development of laws from the first law dealing with the adulteration of food and drink enacted by the British Parliament in 1860. He pointed out that the battle against gross sophistication is practically over, as it is too easily detected and the only form still regularly encountered is the watering of milk. Present-day problems are concerned with ensuring that advertisements do not mislead, that quality is maintained either at a standard specified by law or established by custom, and keeping a watch on the amounts and nature of all kinds of things, from colourings, flavourings, emulsifiers, stabilizers, antioxidants and preservatives deliberately added to process, improve and preserve foods, to accidental contamination with metals or from packaging materials.

In this country, the act which governs the sale of food and drugs is the 1955 Food and Drugs Act, which gathered together and continued the law as it then stood. Other countries have their own food laws which are important in relation to international trade, and result in an enormous amount of legislation with an almost complete lack of uniformity from country to country.

Attempts to produce uniformity on a regional basis are progressing, particularly in Europe and South America, but very little has been done internationally, and even when agreement has been reached for both standards and analytical methods of determining them the problem of enforcement will still remain.

Mr Turner broke the usual custom on these occasions, and answered questions from the audience, after which Mr Myer proposed the vote of thanks.

Chemical Education Debate. The first of the 1961–62 meetings devoted to chemical education was held on 10 October in the Donnan Laboratories of the University of Liverpool, under the Chairmanship of Mr G. H. Turner, Section Chairman. The meeting took the form of a debate on the motion 'That the Concept of Equivalent Weight is now Superfluous.' The suggestion underlying the motion had been made earlier this year by Professor C. C. Addison in the Section's symposium on the teaching of inorganic chemistry at pre-university level (*see J.*, 217), and has since provoked a good deal of interest.

The motion was formally proposed by Mr G. M. Copley, adviser for science to the Liverpool Education Authority. Mr Copley summarized the logical arguments supporting the superfluous and erroneous nature of the concept of equivalent weight considered as a unique property of a substance. Mr E. Hough, senior chemistry master of Prescot Grammar School, then opposed the motion by summarizing the great difficulties which would ensue if the concept of equivalent weight were dropped from the teaching of chemistry, and mentioned its wide use in many fields varying from volumetric analysis to Faraday's laws. His conclusion that the teaching of chemistry would be made more complicated rather than simpler by the abolition of equivalent weight was, on the whole, supported by the majority of the speakers from the floor in the ensuing open debate. After Mr Hough and Mr Copley had summed up their respective cases, the motion was put and decisively defeated by 13 votes to 49.

The total attendance at this meeting was 67; 43 of those present were grammar school teachers.

Role of the Factory Inspector. Mr A. S. Brooman, of the Institute of Petroleum, took the Chair at a joint meeting at the Grosvenor Museum, Chester, on 15 November. Mr A. D. Sill, who was to have given the lecture, had been transferred to another area and his place was taken by Mr J. Lucas, who had recently been appointed to West Cheshire.

Mr Lucas's subject was 'The Role of the Factory Inspector in the Petroleum and Chemical Industries' although, as he pointed out, most of his remarks would apply equally to most other industries. He emphasized the importance of cleanliness, embodying tidiness and easy access to everything, as being paramount in the prevention of accidents of all types; it was, in his experience, the most difficult of all factors to enforce.

More accidents are caused by faulty ladders or faulty use of ladders than by anything else, and the lecturer

illustrated his remarks on this subject by an on-the-spot demonstration of how such accidents are caused, using an imaginary ladder.

The lecturer went on to emphasize the desirability of cultivating the habit of safety as being the most practical way of ensuring that safety regulations are carried out in these days when discipline is not so easy to enforce as it used to be.

Builders and outside contractors came in for a good deal of criticism from Mr Lucas; according to his statistics the accident rate among such workers was eight times the average rate for other industries; plumbers with their blow-lamps are a particular source of danger.

With particular reference to the chemical and petroleum industries, Mr Lucas stressed the need for very stringent regulations regarding the dangers of gassing when entering tanks and other confined spaces; routine precautions should be applied every time, even when clearly unnecessary in order to cultivate good habits.

After the lecture, a lively session of questions was opened by Mr H. R. Jones, who inquired about the psychological approach to the problem. Mr Lucas concluded by giving a method for cleaning the hands after a morning's work on one's car engine: all that is required is to thoroughly wash the hands with olive oil instead of the usual soap or detergent, and then to hold them under running water—the result—a miracle! We have not yet had an opportunity of trying this technique but as Mr Lucas claimed no copyright and spoke with such authority we feel it is worth passing on.

The proceedings closed with the vote of thanks to the lecturer proposed by the Chairman.

LONDON

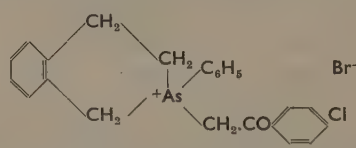
Organic Derivatives of Coinage Metals. The winter programme of the Section opened with a joint meeting at Ewell Technical College of the Kingston Technical College Chemical Society and the Faraday Society of Ewell Technical College on 9 October. Mr P. Raine was in the Chair, and introduced the speaker, Professor G. E. Coates of the University of Durham, who then spoke on 'Organic Derivatives of Coinage Metals.' Professor Coates dealt mainly with the acetylene derivatives of copper. Compounds of the type $R{\cdot}C{\equiv}C{\cdot}Cu$ were first described in 1870 but only recently have their structures been investigated. Techniques such as cryoscopic methods, infra-red absorption spectra and X-ray crystallography have been applied to the problem. Owing to the amorphous nature of many of the compounds, X-ray analysis has proved very difficult, *e.g.* Ph—C≡C—Cu crystallized from donor-character solvents (isopropylamine) gives very small crystals, which are twinned. The introduction of tertiary phosphines gave more tractable materials. Professor Coates considered the structure of these polymeric materials at some length. Understanding of these structural problems was made easier by the use of several excellent slides, and, in particular, by some colour plates of molecular models which emphasized the interesting fact that in the molecule the evidence supports the view that the Cu–Cu distance is the same as that found in the parent metal.

At the conclusion of the lecture several interesting questions were asked. A vote of thanks was proposed by Mr D. P. Neal of the E. T. C. Faraday Society, and the meeting closed after the Chairman had thanked the College authorities for the facilities provided.

Stereochemistry of Nitrogen, Phosphorus and Arsenic Compounds. On 18 October, at a meeting of the Cambridge Sub-Section held jointly with the S.C.I. London Section at Spillers Ltd, Cambridge, the speaker, Dr F. G. Mann, F.R.S., of Trinity College, Cambridge, was introduced by Dr J. Williams, the Chairman.

Dr Mann reminded his audience of Pope and Peachey's classical experiment in 1899, which first demonstrated optical activity due to an asymmetric atom other than carbon in quaternary ammonium salts of the type $[abcdN]^+X^-$. Slow racemization in chloroform of iodides of such cations suggested later why similar optically active compounds of phosphorus and arsenic could not be isolated: there was an equilibrium of the quaternary salt with the inactive tertiary base and an alkyl halide. In fact, Burrows and Turner in 1921 described the formation of $[PhMe_3As]^+I^-$ from the reaction of $PhMe_2As$ and ethyl iodide, a surprising result but explicable by the reaction of unchanged arsine with methyl iodide derived from the dissociation of the intermediate $[PhMe_2EtAs]^+I^-$.

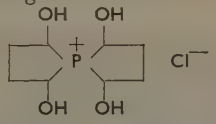
Some forty-four years after Pope's work Holliman and the lecturer produced in 1943 the first optically active quaternary arsonium salt:



This was the bromide of the 2-phenyl-2-*p*-chlorophenacyl-1,2,3,4-tetrahydroisoarsinolinium cation, the picrates of which exhibited $[M]_0$ +457° and −450°. An outstanding feature of the iodide is its optical stability, even in chloroform solution.

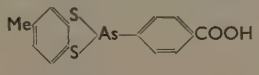
Illustrating his points with models, Dr Mann went on to describe the preparation and resolution of the related spirocylic arsonium salt and their phosphonium analogues. These compounds also possess considerable optical stability. A much simpler route which could lead to optically active spirocyclic phosphonium salts has been shown by workers at The American Cyanamid Co. (Buckler and Wystrach, *J.A.C.S.*, 1958, **80**, 6454)

in the reaction between succinaldehyde, phosphine and hydrochloric acid to give the salt:



After touching briefly on the optical resolution of compounds of the type abcP→O, abcP→S, and abcAs→S, Dr Mann concluded by discussing tertiary phosphines and arsines.

Early values of the frequencies of inversion of the pyramidal phosphine and arsine molecules (5×10^6 and 16×10^4 c/s) suggested little chance of preparing optical isomers. However, the revised figures of Costain and Sutherland (1·4 years and $3{\cdot}5 \times 10^7$ years for the oscillation times of arsine and trideutero-arsine, respectively) had allowed synthetic work to be undertaken with confidence. For example, in 1956, Miss I. G. M. Campbell, at the University of Southampton, had prepared optically stable stereo-isomers of:



True tertiary phosphines had so far proved difficult but not impossible to resolve.

Dr V. P. Wystrach, Dr J. H. Purnell and Mr E. G. Peppiatt were among contributors to the discussion that followed. Mr L. S. Mumford, Chairman of the S.C.I. London Section, proposed the vote of thanks.

Chemical Patents. Coinciding with the twenty-fifth anniversary celebration of the South-East Essex Technical College (19 October), a joint meeting was held with the Chemical Society of the College. The Chairman for the evening, Mr A. J. Turnbull, introduced the lecturer, Dr S. I. Levy, Q.C.

Dr Levy pointed out that patent rights were originally granted by the sovereign by Letters Patent, open letters conferring sole rights or monopolies upon certain persons therein mentioned. When such monopolies were abolished by the Statute of Monopolies in 1623, exception was made of what we now call 'patent rights.' For many years the number of applications for chemical patents was small, Roebuck's patent for sulphuric acid in 1771 being among the few. The number grew rapidly in the nineteenth century and the Patent Office was established in 1883. Modern legislation centres around the Acts of 1907, 1919 and 1949.

The intention behind the granting of patents is primarily the encouragement of commerce. It is not intended directly to reward merit, but only through that means to encourage inventiveness as applied to manufacturing processes. The grant is a form of intangible property giving the inventor the exclusive rights to use or sell the invention and to secure the profits arising for 16 years. The period may, in some cases, be extended by five, or very rarely 10, years.

There are three essential requirements involved. Firstly, the process or article must be directly connected with commerce or manufacture. This excludes pure scientific discovery as such. It excludes new techniques in surgery or medicine, or (in this country but not in America) the breeding of new plants. It includes methods of testing if such methods can be applied to a manufacturing process. Secondly, the process must have some degree of novelty in the United Kingdom. Thirdly, the process must not be obvious. The amount of inventiveness need be only small. There could be no patent for using a mixture of substances in foods or medicines unless some new property appeared in the mixture which differed from the sum of the properties of the constituents.

Dr Levy dealt with the need for careful wording of the specifications. The applicant must not be greedy, claiming rights for, say, a million isomers, when in fact he has tested only two. The claim, which should relate to a single invention, should be clear and succinct. The Courts have ruled that what is not claimed is disclaimed, and also that they will not guess what a claim means if it is not clear.

Dr Levy illustrated his lecture by examples drawn from such cases as that of the manufacture of cordite and tungsten filaments, and the 'trubenizing' of collars, and also several cases of particular interest to local chemists.

This excellent lecture encouraged a number of useful questions which were answered in a most helpful manner. A vote of thanks was proposed by Mr Vale, President of the College Student Union.

Paramagnetic Resonance and its Application. The inaugural meeting of the Kent Sub-Section for the session 1961–62 was held at the Medway College of Technology, Chatham, on 24 October. Mr F. Tweedie was in the Chair and introduced the lecturer, Professor D. J. E. Ingram.

Professor Ingram first explained the basic principles of electron spin resonance and briefly outlined the experimental equipment and techniques. The hyperfine structure of the resonance spectrum due to interaction with the nuclear magnetic moment was then explained. Although used initially by the physicist as a method of determining the nuclear spin, the hyperfine structure is now used by chemists as a means of identification of elements, and in the elucidation of molecular structure.

Some interesting applications of interest to chemists were then described, including:

(*a*) impurity analysis, *e.g.* phosphorus in silicon;

(*b*) the extent of breakdown produced by irradiation of a sample with u.v. light, X-rays, γ-rays or neutrons;

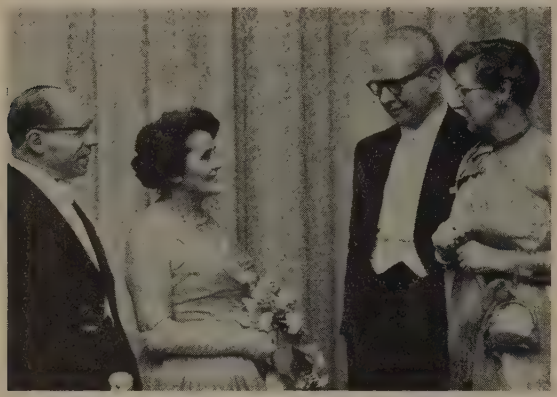
(*c*) the determination of the free-radical content of cigarette smoke;

(*d*) an illustration of the use of the technique in following the kinetics of reactions involving free radicals.

In answering a number of questions from the audience, Professor Ingram stated that at present the accuracy of the method for quantitative analysis was about 7 per cent for comparative measurements, but only about 50 per cent for absolute determinations. He was confident, however, that these figures could be improved by the use of specially designed equipment.

Dr C. E. Seaman proposed a vote of thanks to the lecturer, and praised him for his extremely lucid exposition of the principles and applications of electron spin resonance.

Annual Dinner Dance. About 140 members and guests gathered at the Waldorf Hotel on 27 October for the 13th Annual Dinner Dance of the Section.



Mr and Mrs Raine (*left*) with Dr and Mrs Clow

The Section Chairman, Mr P. A. Raine, presided at the dinner and we were honoured by the presence of the President, Sir William Slater, K.B.E., F.R.S.

The President speaking to Mr G. C. Ackroyd, Hon. Secretary (*right*)

After a most enjoyable dinner, Mr A. J. Turnbull, the Section Vice-Chairman, in sporting metaphors proposed

Mr Turnbull (*left*) with Mr Mumford

the toast of the Institute. The President responded, and his amusing comments on the unfamiliar place names given in the Section's new rules were much appreciated.

Mr Raine proposed the toast of the guests with special reference to the President, regretting the absence of Lady Slater who was not in the country at this time. He cordially welcomed the ladies and our principal guests, Dr A. Clow, head of the science unit of the B.B.C., and Mrs Clow, and Mr L. S. Mumford, Chairman of the S.C.I. London Section, and Mrs Mumford.

Dr Clow responded on behalf of the guests, and his anecdotes and quotations from listeners gave a new insight on the layman's reaction to scientific matters.

The President and Mr P. F. Corbett, Hon. Treasurer (*right*)

Dancing into the small hours concluded a very successful social event. Our congratulations and thanks are due to the Officers of the Social Activities Committee for organizing this happy occasion.

Modern Developments in Co-ordination Chemistry. A joint meeting with the College Chemical Society was

held at the Brunel College of Technology on 2 November. Mr P. A. Raine was in the Chair, and Dr J. Lewis lectured to an audience of over a hundred on 'Modern Developments in Co-ordination Chemistry.'

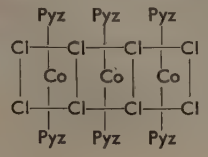
Dr Lewis began by emphasizing the great change that had come over inorganic chemistry since about 1930. Up to that time, inorganic chemistry consisted largely of studying the methods of preparation and the composition of substances. Since then, the great development of valency theory and the increasing use of physical methods of investigation have helped to transform inorganic chemistry into one of the most exciting and rapidly growing fields of science. The use of spectrometric, magnetic, thermodynamic and kinetic studies, in conjunction with new theoretical approaches such as ligand-field theory, has resulted in the breakdown of the barriers which formerly divided physical from inorganic chemistry.

Dr Lewis illustrated the modern approach in inorganic investigation by reference to a recent study of the co-ordination compounds formed by union of cobalt(II) chloride with 2,6-dimethyl pyrazine (Pyz) and with certain methylpyrazines.

The compound $Co(Pyz)_2Cl_2$ is a violet-pink crystalline solid, soluble in nitromethane to give a non-conducting solution in which the solute is monomeric. The absorption spectrum of the solution is completely different from that of the solid. The magnetic moment of the complex in solution is 4·2 BM, whilst that of the solid is higher ($\mu = 5{\cdot}4$ BM) and varies with temperature.

Consideration of transition-metal compounds from the standpoint of electrostatic crystal-field theory makes it possible to deduce from optical and magnetic properties the nature of the environment of the metal ion in complexes. Thus, octahedral co-ordination of cobalt(II) corresponds to a ligand-field splitting value (Δ) of about 10,000 cm^{-1}, depending on the ligand, whilst tetrahedrally co-ordinated cobalt(II) absorbs at longer wavelengths and with greater intensity. Similarly, the magnetic moment of octahedral cobalt(II) complexes includes a high orbital contribution, dependent on temperature, whilst the magnetic moment of tetrahedral cobalt(II) does not vary appreciably with temperature. Pauling's valence-bond approach does not make possible this differentiation between octahedral and tetrahedral cobalt(II).

Application of these criteria to $Co(Pyz)_2Cl_2$ in the solid and the dissolved states leads to the conclusion that in solution the cobalt is tetrahedrally co-ordinated whilst in the solid there is octahedral co-ordination, presumably brought about by halogen bridging:



There is some indication that such chains of octahedral groups may be terminated by tetrahedral groupings.

After questions, Mr C. C. Moore, Secretary of the College Chemical Society, proposed the vote of thanks for an interesting and stimulating lecture.

Physical Methods in Archaeological Research. A joint meeting with the East Anglia Section and Cambridge University Chemical Society was held on 10 November, in the Lensfield Road Laboratories, Cambridge. Dr F. G. Mann, F.R.S., Vice-President of the C.U.C.S., opened the proceedings and asked Mr Raine, Chairman of the London Section, to take the Chair.

In a short introductory address, Mr Raine indicated his pleasure at the success of this Annual meeting with the C.U.C.S., now arranged by the 'thriving Cambridge Sub-Section' and welcomed the lecturer, Dr E. T. Hall.

Introducing his subject, Dr Hall showed how modern physical methods enabled the archaeologist to carry out his work more efficiently, without 'trial-trenching' on excavation sites. It is also possible with recently developed techniques to trace ancient trade routes by following the introduction of materials from places foreign to the point of actual discovery. During the course of the lecture much of the work being carried out in the lecturers' department at Oxford was discussed, the more important methods being explained in detail.

The question 'where to dig' was considered at some length. The use of aerial photographs is of great importance and much information is thereby obtained. In a method developed at Oxford, measurement of the earth's magnetic field over a site before actual digging begins gives a plan showing the most fruitful places for excavation. Dr Hall explained how the presence of (*a*) baked clay from kilns or hearths, (*b*) top soil pockets in the sub-soil from ancient pits and the like, and (*c*) concealed stone walls, would give an anomalous measurement of the earth's magnetic field at those points. By use of the 'Proton Magnetometer,' developed at Oxford, a site of several acres could be 'mapped' in a few days.

The analytical methods in current use were of great interest. X-ray fluorescence analysis had been applied to date the blue pigments on Chinese ceramics; by comparing the manganese : cobalt ratio the use of different cobalt pigments was discovered. Indigenous supplies of the pigment having a high manganese : cobalt ratio were obtainable by the eighteenth century, whereas earlier artists had used imported pigments with a low manganese content; thus the period of manufacture was now readily ascertained.

After pointing out that the normal emission spectrometer still had a large part to play in archaeological research, the lecturer showed how comparison of the ratios of carefully chosen elements enabled the modern archaeologist to locate the origin of specimens.

A typical problem solved by the use of neutron activation analysis was the origin of Corinthian silver. It was

not known if the silver used in Corinthian coins was from Athenian mines or from elsewhere. By neutron bombardment in the Harwell pile the gold content of both Athenian and Corinthian silver coins was compared, and the Corinthian silver was shown to be of different origin, since it had a far higher gold content. The Athenian silver was of high purity and Dr Hall speculated on the possibility of the Athenians having had some refining technique, this being considered a rather difficult task in the light of the technological knowledge of the period.

The lecturer ended with an example of overpainting detected by the use of X-rays, indicating the work done in the field of art.

The vote of thanks was proposed by Mr Alcock.

MANCHESTER AND DISTRICT

Chemistry of Colour Photography. On 12 October at the Technical College, Bolton, Dr E. Macdonald gave a lecture on colour photography. He began by giving a brief outline of the principles on which colour photography is based. White light and all the colours of the spectrum can be obtained by mixtures of three main primary lights, blue, green and red, colours to which the eye is sensitive. This was successfully demonstrated by Maxwell, who in 1861 accurately reproduced the colours of a tartan ribbon by projecting the three photographic separation positives through blue, green and red filters and superimposing. A modern development of this type of 'additive' process is Dufaycolor.

In 1869, DuHauron showed that combination of yellow, magenta and cyan (blue-green) filters in the same *beam* of light (subtractive process) could also produce all the colours of the spectrum. Dyeing separation records with such dyes is the basis of the Technicolor process. A method of producing the required yellow, magenta and cyan dyes by the colour development of exposed silver-halide emulsion layers in the presence of colour formers was devised by R. Fischer in 1912 but was not utilized for about 20 years. Dr Macdonald described the manner in which this reaction and other organic chemical reactions had contributed to the present-day status of colour photography.

The make-up of modern materials such as colour transparencies, colour negative and colour paper and the processing involved were suitably demonstrated on an ingeniously devised illuminated screen, and also by chemical experiments. Mr Macdonald concluded by showing examples of the materials now available, particularly colour prints.

Mr A. J. Jenkinson, principal of Bolton Technical College, expressed in his vote of thanks the appreciation of all present for a most interesting and attractive lecture.

MID-SOUTHERN COUNTIES

Trace Analysis in Archaeology. On 20 October, at the Red Lion Hotel, Salisbury, a joint meeting was held with the S.A.C. Microchemistry Group and the Western Section of the S.A.C., under the Chairmanship of Mr D. H. Bell. Dr E. T. Hall, director of the Research Laboratory for Archaeology and the History of Art, University of Oxford, gave a lecture entitled 'Analytical Techniques in Archaeology and the Arts' and Mr. J. W. G. Musty one on 'The Application of Spectroscopy to the Study of Roman and Medieval Glazed Pottery.'

Dr Hall began his lecture by describing magnetic methods for archaeological field surveys. Changes in the earth's magnetic field could be detected by a portable proton magnetometer, and increases in this field were observed for kilns, pits and also buried tin cans and barbed wire, and decreases for buried walls. Four non-destructive methods of analysis were described.

(*a*) Neutron activation followed by X-ray spectrometry—by this method Athenian silver was shown not to have been used in the minting of coins from Corinth; it was of interest that Athenian silver of those days contained very small amounts of gold indeed.

(*b*) Emission spectroscopy—the difference in lead content of bronze from the early and middle bronze ages was found by this analytical procedure and used to confirm other archaeological findings. Specimens of pottery from Mycenae and Knossos were also shown to be dissimilar. Romano-British mortaria kiln areas show distinguishable differences in constituents.

(*c*) X-ray fluorescence—by using this method to determine manganese : cobalt ratios in Chinese porcelain, it had been possible to distinguish three periods of time: A.D. 1300–1400, imported ore; 1400–1600, imported and home ore; and 1600 onwards, home ore only.

(*d*) Electron-emission microanalysis—Dr Hall concluded his lecture with a description of this apparatus, which had been specially constructed for solving archaeological problems.

Mr Musty began his lecture by saying that one problem in applying scientific techniques to archaeology was the interpretation of the results. The archaeologist often found difficulty in framing his questions, and the scientist on the other hand might be tempted to draw conclusions at variance with archaeological experience. No matter how precise the scientific results, these could only be interpreted in conjunction with the imperfect archaeological data.

Hitherto the study of early glazed pottery had depended on typological comparisons, but the spectroscope and other analytical methods clearly provided a means for a more detailed examination of the material, although the results might not always be readily interpretable. Analyses of Roman and medieval glazes had been first obtained by Mr E. M. Jope, and more recently a large number of medieval glazes (ninth to thirteenth centuries A.D.) had been analysed by Mr L. C. Thomas in collaboration with the lecturer.

Spectroscopic analysis was shown to be of some help in the problem of demonstrating that, although lead-glazed pottery was imported into Britain during the early Roman period, it was also made in this country at that time.

Subsequently, the art of glazing pottery seems to have died out in Western Europe, but it reappeared in England in the ninth century A.D. with the manufacture of the distinctive Stamford ware of East Anglia, which must be recognized as the first English glazed pottery. It was not, however, until the thirteenth century that large-scale production of glazed pottery occurred in kilns all over England. Between the ninth and twelfth centuries the knowledge of glazing techniques probably spread from England to the Low Countries, and by the thirteenth century a small amount of glazed pottery was being imported into this country from the Continent.

The lecturer gave a detailed account of his work with Mr Thomas on the spectroscopy of pottery from the thirteenth-century kilns at Laverstock, near Salisbury, and other pottery of the period, including Continental material. This work had confirmed, for instance, the idea advanced originally on archaeological grounds that a technological link existed between East Anglia and the Low Countries.

Mr Musty concluded his lecture by referring to some problems where the spectroscopist did not wholly agree with the archaeologist, and gave examples of pottery specimens which were typologically similar but gave markedly different spectra. For instance, a jug found at Bergen, Norway, which he himself had assigned on archaeological grounds to the Laverstock kilns, could no longer be so considered.

Both speakers showed slides and answered many questions.

Mr D. W. Wilson proposed the vote of thanks.

Pharmacy in the U.S.A. and U.K. On 26 October, Dr A. H. Beckett, head of the School of Pharmacy at Chelsea College of Science and Technology, lectured to members of the Section and members of the Fawley Branch of the Institute of Petroleum and the Bournemouth Branch of the Pharmaceutical Society. He took as his subject 'Pharmacy in the United States and Great Britain—A Comparison and Contrast.' Mr W. F. Thorne was in the Chair.

Dr Beckett illustrated his lecture with his own excellent colour slides taken in the United States. He contrasted the training of pharmacists in that country with the system at present in operation in the United Kingdom. Details of the various courses were given, and the prospects of qualified pharmacists in both countries were critically compared. The lecturer gave an outline of the courses at present in operation at Chelsea, and also commented on the research being conducted there.

Dr R. E. Parker proposed the vote of thanks.

Abatement of Pollution. At a joint meeting of the Section with Poole and District Technical Group on 31 October, members heard a lecture by Mr A. W. W. Kirby, of the Shell Refining Co. Ltd, who took as his subject 'The Abatement of Pollution — Random Thoughts of an Oil Refiner.' Mr Kirby, who serves on national and international committees concerned with the abatement of pollution in all its forms, dealt in particular with the pollution of beaches. He said that the only solution to this problem was the total prohibition of oil discharges at sea. The pollution caused by the various refineries scattered around the coasts of Britain is insignificant. An International Commission was discussing this particular problem at the present time, and it was earnestly to be hoped that legislation would be agreed on, making it illegal to discharge oil at sea.

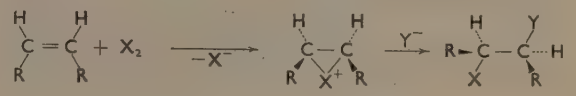
Referring to pollution of the atmosphere, Mr Kirby mentioned the Los Angeles 'smog.' This type of 'smog' is unique to Los Angeles, which has the highest number of cars in the world. The Americans have developed two types of equipment to combat this problem; one consists of a simple after-burner requiring a pilot flame, the other is a catalytic after-burner. A prototype of the latter has already been approved and will be fitted on all new cars in California by 1963 and on all old cars by 1965. The lecturer said that there was no acute hazard to health in other parts of the world if vehicle exhausts were properly adjusted.

Two very topical colour and sound films were shown; one, entitled 'You and Your Diesel,' showed how easy it is to avoid obnoxious diesel fumes by the use of a good-quality fuel and lubricating oils; the other film, entitled 'Watch on the Spey' explained how Scottish distilleries dispose of their effluent. Gone are the days when this was simply allowed to soak away. Modern effluent-disposal plants have now been constructed which convert the distillery effluents into useful by-products, and the water which returns to the rivers is completely uncontaminated.

The vote of thanks was proposed by Mr J. Hendry.

Halogenation of Aromatic Compounds. On 3 November a meeting was held jointly with the Southampton University Chemical Society at the University of Southampton. A lecture entitled 'Addition accompanying Substitution in the Halogenation of Aromatic Compounds' was given by Professor P. B. D. de la Mare.

Professor de la Mare opened his lecture by discussing addition of chlorine to olefins, a reaction which involves electrophilic chlorine, $Cl^{\delta+} - - - Cl^{\delta-}$, and is generally thought to proceed by a step-wise *trans-* process, thus:



He adduced evidence that the formation of intermediates of this type can affect the ratio of isomeric products in the related substitution reactions involving olefins. He then discussed electrophilic chlorine substitution in aromatic compounds, and illustrated by reference to recent work on biphenyl, on its homologues, and on fluorene, that this process is often accompanied by heterolytic addition.

Professor de la Mare concluded by discussing the chlorination of phenanthrene, from which most of the dichloride adduct is formed by *cis*-addition. Evidence was presented that more than one intermediate is concerned in the reaction. It was suggested that in heterolytic processes involving chlorine it will probably be discovered that *cis*-addition is more common than has generally been thought.

The lecture was illustrated with slides. After questions, the vote of thanks was proposed by Dr Parker.

Chemical Experiments with Light. This year's lecture for sixth-form science students, held jointly with the Science Master's Association, was given on successive days at Portsmouth and Bournemouth.

On 9 November, Dr E. J. Bowen, F.R.S., lectured on 'Chemical Experiments with Light' at Northern Portsmouth Grammar School. He began his lecture by discussing various means of producing light and explaining the modern refinement, the fluorescent lighting tube. He demonstrated phosphorescence and fluorescence and showed that many substances fluoresce —from Ichthyosaurus bone to human teeth. Many uses of fluorescence were demonstrated, and we learnt that fluorescence was used in 1878 to show that the rivers Danube and Rhine had the same source. The secret of 'whiter than white' was a fluorescent agent (optical bleach). The nature and use of polarized light was next discussed and demonstrated, especially the orientation of molecules undergoing crystallization and strain pattern in a piece of glass. The lecturer concluded with a demonstration of the chemical production of light in a cold solution.

The vote of thanks was proposed by Mr W. T. Tweed, senior science master.

Dr Bowen lectured to another audience of grammar and public-school sixth-form science students in the new Bournemouth School for Girls, Strouden Park, on the following day. The lecture was held in the school hall, which was filled almost to capacity. This school was built in 1960–61, and was brought into use at the beginning of the autumn term.

On this occasion students were permitted to put questions to the lecturer and the vote of thanks to the speaker was proposed by the headmistress, Miss M. G. Key.

The Section counts itself most fortunate to have secured the services of an eminent speaker, and over 800 students attended. The attendance was most encouraging to the organizers, and arrangements are already being made for another series of schools lectures in the new programme.

NEWCASTLE UPON TYNE AND NORTH-EAST COAST

Oxidation of Organic Compounds. The first meeting of the 1961–62 session was held on 19 October in the chemistry department, King's College, Newcastle upon Tyne, when Professor H. B. Henbest, of the Queen's University of Belfast, spoke on 'Oxidation of Organic Compounds: Some Recent Work.'

The study of the oxidation of dimethylaniline and some related amines is revealing because different products or groups of products are formed, depending on the mechanism of the initial attack of the oxidizing agent. In all, 12 products have been obtained from dimethylaniline; their formation was discussed under five main headings.

(i) Addition of oxygen occurs in the formation of dimethylaniline *N*-oxide from dimethylaniline and hydrogen peroxide.

(ii) Oxidation via removal of an electron. Oxidation of tri-*p*-tolylamine with iodine and silver perchlorate gives the insoluble salt $(p\text{-}MeC_6H_4)N^{\cdot+}(ClO_4)^-$. Oxidation of dimethylaniline with ceric salts or alkali ferricyanides gives tetramethylbenzidine, probably via the reactive radical cation, $Me_2PhN^{\cdot+}$.

(iii) Oxidation via removal of a hydrogen atom. This can be accomplished by generating t-butoxy radicals, thermally or photochemically from di-t-butyl peroxide, in a solution of the amine. Hydrogen is transferred almost quantitatively from the amine to the butoxy-radicals, and the diamine, $(C_6H_5N(Me)CH_2)_2$, is the main product.

(iv) Dimethylaniline reacts with the high-potential quinone, 3,3′,5,5′-tetrachlorodiphenoquinone to give methylaniline and bis(4-dimethylaminophenyl)methane. A possible route for the production of these compounds involves initial transfer of hydride ion from the amine to the quinone. Dealkylation occurs in very high yield with dimethyl-*p*-toluidine, the secondary amine being formed in more than 95 per cent yield. Substituted amine derivatives of triphenylmethane and its cation are formed on further oxidation of bis(4-dimethylaminophenyl)methane and dimethylaniline under appropriate conditions.

(v) In the presence of hydrated manganese dioxide, dimethylaniline is converted into *N*-methylformanilide.

Anisole reacts less readily than dimethylaniline with t-butoxy-radicals, and the yields of simple products are lower. At 140° the major product is a mixture of isomeric phenoxymethylanisoles, but at 40° the symmetrical diether, $(C_6H_5OCH_2)_2$, is formed in larger amount.

NORTH WALES

Women in Technology. The first meeting of the session was held at Flintshire Technical College, Connah's Quay, on 29 September. The lecturer on this occasion was Miss Mamie Olliver, who spoke on the very interesting topic 'Women in Technology.' Sixth-form students from the grammar schools in North Wales and Chester were invited, and about 50 girls attended. In addition, some youth employment officers and industrial training officers were present. Mr N. F. Rapps, Section Chairman, presided.

Miss Olliver said that although women are making valuable contributions towards the advance of technology, they form only a small proportion of the technologists in this country. She suggested that one of the main reasons for this could be found in girls' schools. To illustrate her point, she showed histograms of the relative number of passes obtained by boys and girls in the main arts and science subjects taken in 1960 at the 'O' and 'A' levels of the G.C.E. Similar analyses of honours degrees showed that, whilst women maintained a level of achievement equal to that of men in English and French, the proportion of successes in technological subjects was relatively low. These differences could be the result of the unequal teaching of boys and girls resulting from the shortage of science teachers of the right calibre, which is an especially serious problem in girls' schools. Expenditure on laboratory accommodation and equipment, which is recognized as inadequate in many boys' schools, is frequently less for girls.

Whilst women scientists are needed primarily as teachers in schools, they are giving valuable service in other branches of educational work and are in demand by all types of research organizations. The position in industry is, however, more complicated and although women technologists are being used in the laboratories, libraries and drawing offices, opportunities in production management are extremely rare. This is due to a number of factors, which were discussed by the speaker. In conclusion, Miss Olliver mentioned some of her own experiences in research and in production quality control to illustrate the work which is being carried out by women technologists in industry.

The lecture inspired some interesting questions from the girls present, and general discussion indicated that meetings of this nature are most beneficial to young people who are about to leave school. The vote of thanks was proposed by Dr W. R. Angus.

SOUTH WALES

Works Visit. On 21 September a party of members joined members of the local section of the Institute of Petroleum on a visit to the new Esso refinery at Milford Haven. The visitors were received by the technical superintendent, Mr J. G. Godden, who gave an introductory talk on the siting and layout of the refinery. As the area is one of outstanding beauty, he pointed out the care which had been taken in placing the refinery in a natural ravine which conceals the installation from the landward side, with the exception of the necessary 300-ft effluent stacks.

After a reception and lunch the party divided into two groups to tour the refinery. The control room, the nerve centre of the refinery, was visited, and members were able to see the high degree of process-control automation required for modern plant. One of the most pleasant visits was the drive along the 1,000-yd long deep-water jetty, from which there is a magnificent view of the Haven. The jetty has anchorage facilities for two 100,000-ton incoming tankers and one 5,000-ton outgoing coastal tanker simultaneously.

In the chemical laboratories the groups were met by the chief chemist, Mr Brading, and further divided into smaller groups to be taken round by his staff. Members were most impressed by the modern methods of oil analysis, which included automatic distillation and flash-point determinations, radioactive determinations of sulphur and vapour-phase chromatography.

Tea was then taken in the lecture hall and the two chairmen, Mr Hermas Evans (R.I.C.) and Mr Hooper (I.P.), welcomed the Esso Company to the area and detailed the activities of the Institutes, expressing the hope that the refinery staff would be able to attend meetings at Swansea (R.I.C.) and B.P. Ltd, Llandarcy (I.P.). It was also hoped that the success of this inaugural visit of the two societies to Pembrokeshire would be followed by others. Thanks were expressed to Mr Asquith, refinery manager, for the hospitality of the Esso Co. Ltd, and to Mr Godden and his colleagues for their untiring efforts in ensuring the success of the visit.

Tea was followed by a joint meeting of the two societies with Mr Hooper in the Chair, and two papers were presented. Mr A. Anderson, of the technical department of Esso, delivered a paper on 'Ammonia Manufacture from Petroleum Feed Stock' and Mr G. Drake, of Fisons Fertilisers Ltd, who are soon to establish a factory adjacent to the Milford refinery, gave a paper on 'Modern Processes for Nitric Acid Production.' Mr Anderson reviewed the methods of preparing synthetic gas for ammonia synthesis, which are: (1) hydrogen removal from reformer off-gas; (2) partial oxidation of petroleum feed-stock, *e.g.* $CH_4 + O_2 \rightarrow CO_2 + 2H_2$; (3) steam reforming, *e.g.* $CH_4 + H_2O \rightarrow CO + 3H_2$. The first does not produce hydrogen and the third is cheaper than the second, since no air-liquefaction plant is required. After describing the methods of purification of inlet gas and syn-gas, the speaker gave a concise account of the conditions for ammonia synthesis and the modern type of ammonia converters.

In the second lecture Mr Drake gave an historical account of the methods of producing nitric acid, with a

detailed discussion of the modern methods based on ammonia oxidation.

Both lectures were of considerable interest to an audience composed of a wide range of pure and applied chemists, as was shown by the vigorous discussion which followed. The vote of thanks to the speakers was proposed by Dr Islwyn Jones. To conclude a memorable day, on the return journey the Swansea-based members stopped for refreshments at an appropriate establishment, and were entertained by members of the B.P. Male Voice Choir.

SOUTH-WESTERN COUNTIES

Chemistry and Pharmacy. A meeting of the Section was held in the Technical College, Plymouth, on 10 November. The Chairman, Mr E. Winterbottom, introduced Dr Leonard Saunders of the University of London School of Pharmacy, who delivered a lecture entitled 'Chemistry and Pharmacy.' Dr Saunders said that the separation of chemistry from pharmacy had its origins in the medical theories of Paracelsus, which had a considerable influence in changing the sixteenth-century apothecary from a herbalist into a chemical pharmacist. Towards the end of the eighteenth century, sufficiently clear notions about the compositions of substances had been formulated to permit the development of chemistry as a distinct science. Pharmacists played an important part in the early discoveries in chemistry, for example all the four halogens were discovered by pharmacists.

By the mid-nineteenth century both the Chemical and Pharmaceutical Societies had been founded in London and chemistry was well established in its own right. In 1842, the Pharmaceutical Society opened the School of Pharmacy in Bloomsbury Square, and two years ago its new premises in Brunswick Square.

Until 1950, the training at the School was mainly for diplomas; after this date the new three-year course for the B.Pharm. degree of London University became the only course available at the School. The extra year has meant that more scientific theory can be included in the pharmacists' training, and in particular that the study of physical chemistry can be developed to a better standard. Present courses in this subject include more advanced theory and practical work in physical analysis and radiochemistry.

The great contributions of synthetic organic chemistry to medicine have resulted in this subject playing an important, indeed a dominating, role in pharmaceutical chemistry. The traditional work of the pharmacist, the making of preparations for use in medicine, is tending to pass from the individual pharmacy to the manufacturer. The pharmacist carrying out this work in industry would be greatly helped by a really sound background of physical chemistry, and it seems likely that physical chemistry will play an increasingly important part in chemistry applied to pharmacy.

Following a discussion Mr J. M. Johnson, of Saltash Grammar School, proposed the vote of thanks to the lecturer.

An informal dinner, at which Dr Saunders was the guest of the Section, was held afterwards at the Duke of Cornwall Hotel.

DECCAN

Chemical Revolution. At a meeting held on 4 October, Dr M. C. Munshi, of the Section of Economics and Social Sciences, Indian Institute of Science, delivered a lecture on 'The Chemical Revolution and the Second Industrial Revolution' at the Indian Institute of Science, Bangalore. Dr B. H. Iyer presided.

Dr Munshi said that 'the chemical revolution' means the tremendous changes that have resulted from the application of the great discoveries in chemistry and physics at the turn of the century, and their impact on the technical and economic structure of the chemical and other industries. A new chemical civilization dawned, with an astonishing range of new substances and products, many of which had never been seen before in nature. These profoundly influenced chemical operations and technological progress, and led not only to the production of many more inorganic and organic materials but to greater and very often new applications of processes involving the use of high temperature, especially in electric furnaces, electrolysis, fermentation and so on for the manufacture of still newer products. These and other developments, including the exploration and exploitation of natural gases and petroleum as chemical raw materials, and employment of electric energy for processing a great variety of synthetic substances, heralded a new era in man's economic and social life.

The 'second industrial revolution' means a fundamental change in the economic system of production, an enlargement of industrial processes and a replacement of natural resources by synthetic materials. Many changes were brought about by new sources of power and mechanization, and they resulted in the transformation of distribution functions and organization of industries.

The chemist would classify such new industries by their end-products: medicines, fertilizers, insecticides, fibres, plastics and electronics, gums, resins, glues, perfumes and flavours, and even alloys, all of them being made to exacting specifications of physical characteristics and chemical quality. The economist would describe these productive enterprises as constituting a second industrial revolution in the sense that they involved a process in which a new series of strategic production functions took place and are still taking place. They involved the basic changes that accompany the mechanization of an enterprise, the building of a new industry, the opening of a new market and a process of deepening as well as widening of capital. These changes mean for

the economist not only a whole range of new consumer products but the advent of a stage of economic growth which is described as one of high mass-consumption. So far only a few countries have reached this stage after emerging from a stage of mature economic development.

The lecturer drew a number of conclusions relating to the scope and magnitude of chemical endeavour in these industries, and to the technical processes resulting from them: the emphasis on production engineering in relation to the new field of chemical engineering; the changes in financial organization; the proximity and close interplay between laboratory and factory; the influence of science and scientific research; scientific research and entrepreneurship; and finally the State as an entrepreneur and sponsor of industrial and scientific research.

Dr S. C. Pillai proposed the vote of thanks.

Madras

Special General Meeting. At a Special General Meeting, held at the Madras Christian College, Tambaram, on 9 September, it was resolved that the financial year should be from 1 January to 31 December instead of, as at present, 1 August to 31 July. It was also decided that the A.G.M. be held in January each year. These changes were ratified by the Council on 20 October and are now effective.

After the business meeting, Dr S. V. Anantakrishnan, Section Chairman, spoke on 'Solvent–Solute Reaction.' Dr A. R. Natarajan presided.

The lecturer said that in studying the subject of solvent–solute interactions two distinct aspects arise, the first dealing essentially with equilibrium properties of solutions and the second covering the whole range of solvolytic reactions. From the different methods of considering the behaviour of solutions it would now appear that a more correct picture is given from interaction energy, collision diameter and the modern concept of an ideal mixture. By taking into account an additive relationship between interactions, energy terms and configurational terms, an equation can be set up for the free energy of mixing which yields values for all equilibrium properties of solutions. Not only must dipole interactions be taken into account but other types of intermolecular forces as well. Old textbook representations of the acidic or basic nature of aqueous solutions of inorganic compounds must be replaced by the new picture of aquo-complexes, which dissociate in stages and in which polynuclear species can also be formed. The extent of lability of the water molecules associated with the central atom of the ion in such aquo-complexes can sometimes be indicated in exchange reactions by using isotopic species. This was illustrated for the systems Fe(II), Fe(III); Cr(II), Cr(III); V(I), V(II); and Cr(III), Cr(VI). The results were compared with those from other techniques and methods.

Dr Natarajan proposed the vote of thanks.

News and Notes

Instrumental Methods of Analysis.—A symposium, organized by the Hull and District Section of the Institute, on 'Recent Advances in Some Instrumental Methods of Analysis,' will be held at The University, Hull, on Saturday, 6 January, 1962.

The morning session will include papers on polarography (Dr G. F. Reynolds), infra-red analysis of inorganic compounds (Dr B. J. Hathaway) and spectrofluorimetry (Dr C. A. Parker). In the afternoon session papers will be presented on the application of mass spectrometry to analytical problems (Dr G. C. Bond) and atomic absorption spectroscopy (Mr R. Lockyer). There will also be an exhibition of apparatus and textbooks.

Further details and application forms can be obtained from Mr C. E. Rhodes, Reckitt & Sons Ltd, Dansom Lane, Hull.

Annual Physical Exhibition.—The 1962 Annual Exhibition of the Institute of Physics and the Physical Society will be held at the Royal Horticultural Society's Halls at Westminster, London, S.W.1, and will be open as follows:

Monday, 15 January, 2 p.m.–7 p.m.
(Members and press only, 10.30 a.m.–2 p.m.)
Tuesday, 16 January, 10 a.m.–9 p.m.
Wednesday, 17 January, 10 a.m.–7 p.m.
Thursday, 18 January, 10 a.m.–7 p.m.
Friday, 19 January, 10 a.m.–1 p.m.

Members of the Institute who are not members of the Institute of Physics and the Physical Society but wish to attend the Exhibition on the Members' morning (15 January, 10.30 a.m.–2 p.m.) should send their **request for a special admission ticket** on a postcard addressed to the Editor, Royal Institute of Chemistry, 30 Russell Square, London, W.C.1, by 5 January. Tickets for the other times may be obtained from the Institute of Physics and the Physical Society, 47 Belgrave Square, London, S.W.1.

Chemical Engineering and Automation.—CHISA 1962, the First International Congress on Chemical Machinery, Chemical Engineering and Automation, will be held in Brno, Czechoslovakia, on 3–8 September, 1962, just before the Fourth International Trade Fair, which will be officially opened on the afternoon of 8 September. Original scientific contributions are expected to be presented by authorities in the fields mentioned, and simultaneous translations will be provided into English, Russian and German. All inquiries should be addressed to: Organisační výbor 1. Mezinárodního kongresu chemického inženýrství, strojnictví a automatisace, Výstaviště 1, Brno, Czechoslovakia.

Food Technology.—A First European Symposium on Food Technology took place on 25–27 October in the Dechema-Haus, Frankfurt (Main), Germany. Scientific and practical problems of food technology were dealt with in 22 plenary lectures and papers, followed by discussions covering the various technical stages in processing foods—drying and evaporating, homogenizing, purifying and sterilizing, the use of refrigeration and vacuum techniques and the problem of storing stocks. Dr F. H. Banfield was a member of the organizing committee of the Symposium.

Industrial Uses of Sugar.—The Sugar Research Foundation, Inc., which is supported by the sugar industry in Great Britain, Canada and other countries, provides grants for research in its various member countries.

At Bristol, Dr Leslie Hough is engaged in work on improved methods of producing sucrose-carbonate polymers of use in plastics. Professor Maurice Stacey, F.R.S., at Birmingham, is studying methods to prepare a more economical family of sugar-derived substances for use in the detergent field. At the Royal Holloway College, Professor E. J. Bourne is continuing research on certain derivatives of sugar which may yield plastics.

The Yarsley Research Laboratories Ltd, Chessington, will conduct two projects: the use of sugar in developing resins for surface coatings, insulators and moulded articles, and the reaction of sugar with heavy-metal oxide compounds, which, it is hoped, will yield useful cements and adhesives.

MANAGEMENT OF RESEARCH

A Seminar on this subject was held under the auspices of the OEEC (Organization for European Economic Co-operation) in Hornbaek, Denmark, on 24–30 September. The proceedings were in English and this was the third of such Seminars, previous ones having been held in Austria and France. Representatives from 12 countries attended, covering 12 different disciplines of science and technology. Eighteen of the delegates were chemists, and included representatives from D.S.I.R., colleges of advanced technology, research associations and industrial research groups. The total attendance was limited to 40 persons, and the topics discussed were considered by groups of about nine delegates from different countries and of different disciplines. The conclusions reached were summarized at a final plenary session. The three topics discussed were:

1. How is a research programme built up?
2. How is a research programme serviced?
3. How should a successor to a research manager be trained?

After discussion on the first topic, it was concluded that industrial research programmes are built primarily on short-range projects of one or two years' duration, mainly devoted to applied research. In contract research, however, the solution of long-range applied problems is involved and periods of up to three years or more are quite usual. In academic research, by way of contrast, research involves one project leading into another, and the research manager must be prepared to modify the programme as circumstances dictate. It was felt that university-type institutions might accept a limited amount of contract research, but this needed most careful watching. In company research, the projects may originate from the demands of the market, from the products of the company, from the needs of the production side or from a desire to meet future sales prospects. In all organizations, whether industrial or academic, the stimulation of new ideas by discussions with those outside the organizations was considered valuable.

The second question, 'How is a research programme serviced?' was described by one eminent speaker as being 'the housekeeping aspect' of the research work. Another speaker referred to the three M's of a research programme, namely: men, masonry and materials. Discussion was concentrated mainly on the men. Differentiation was made between fundamental work carried out for its own sake and applied research, which was described as a conversion of science to technology. It was accepted that all research workers are, above all, human beings, and even in some respects a little immature, particularly in respect of their persistent childlike (but not childish!) inquisitiveness which leads them to the exploration of the unknown. On the other hand, the research worker as a rule shows greater maturity in that his judgments in scientific matters, even if not in others, are more considered and less emotional than those of other people.

When the final question, 'How should a successor to the research manager be trained?' was dealt with, it was accepted that it was a difficult subject to discuss; but in retrospect it was agreed that this discussion proved one of the most interesting and valuable of the Seminar. In essence, training one's successor is training every individual member of the staff as a potential leader and, possibly, as the successor to the research manager or to someone else. It is therefore a continuous process and a problem in human relations. The factors which should be sought in potential research leaders for the future were thought to be leadership, scholarship and broad experience.

A number of recommendations to OECD (Organization for Economic Co-operation and Development—successor to OEEC) were framed and it was felt they should be incorporated, together with the main conclusions of the Seminar, in a pamphlet. All agreed that the meeting had been a success and of value, and that more such seminars should be organized both for experienced and potential research managers. A course

in research management should be organized as an experiment, and studies by social scientists of the research worker in his research environment should be encouraged. The value of interchange of research workers between research organizations had been stressed and organizations should be encouraged to facilitate such interchanges and also to allow their workers sabbatical leave to enable them to widen their experience by independent study or research. The merits of the double-line method of promotion and salary assessment were stressed, a method which allows research workers to be promoted solely in recognition of research capability in addition to the usual promotion in recognition of administrative responsibility. It was also agreed that those bodies and organizations responsible for the administration of higher education which do not at present recognize research work in institutions not under their control as appropriate for the award of higher degrees, or do not recognize the staff of these institutions as supervisors of such research, should be encouraged to reconsider their attitude.

CORRESPONDENCE

Research and Development

SIR,—I was very interested to read Dr W. A. Caldwell's brilliant article on the above subject in the October number of the *Journal* (p. 358); I think it shows a wider experience and comprehension than any other I have come across.

Just two years ago I published a short article on the same subject, entitled 'Making Research Profitable to Industry' (*Engineering Materials and Design*, November, 1959, 557), and was at pains to emphasize the vital point often not understood by academics new to industry, that industry will undertake research and development only because it will make *money*, as Dr Caldwell now says.

Taking up some points in Dr Caldwell's article, I would emphasize that the director should concentrate on avoiding starting on 'insoluble problems.' By this I mean problems on which several other people have worked without success.

Of the problems coming in from outside, probably four out of five are economically insoluble. Some of these projects have to be started because of the pressure of higher authority, but they should be cut off ruthlessly as soon as ever possible.

On many problems a search of the patent literature is usually the quickest guide—much quicker than attempting to plough through 100 articles in chemical or other journals.

The re-examination of the private reports kept in one's laboratory may prevent duplication of the work; these reports, however, may not be much use if the man who did the work is no longer available.

Product Improvement. 'Forced on us by competition': I feel here that one should foresee the position and have the improvement ready—thus leading the market, not always trailing behind, as so many do. Occasionally one may get caught, but this is the fault of salesmen rather than the R and D. Sales must be taught and encouraged to report everything they see or hear about new products or devices; regular meetings between sales, R and D executives, and works must be held.

Technical service workers, so-called service engineers or chemists, are not usually knowledgeable enough to conduct their own laboratory investigations, and can become a great nuisance in the laboratory. They should rather bring their problems (and sometimes the customer as well) to the senior laboratory chemist and the latter work out how to deal with them.

In conclusion I would say that, for efficiency, industrial R and D must be *directed* and *not* run by committees. Committees, with their endless discussions, can waste years, destroy interest, and then only produce mediocre work too late for the competitive market.

L. H. CALLENDAR

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SIR,—In his most percipient address, Dr Caldwell draws attention to the problem of rewarding inventive chemists in industry. He points out that the British principle is for there to be no direct link between the value of a chemist's inventions and his remuneration, as this 'tends to stifle the free interchange of ideas which rightly or wrongly most British companies tend to consider an important factor in successful invention.'

It may, however, be noteworthy that in Germany, where neither the effectiveness nor the status of industrial chemists is exactly negligible, just the opposite principle of rewarding invention seems to be practised. This was put recently* by the director of research of Farbwerke Hoechst AG as follows: 'The fact that the company is required by law to remunerate a research chemist who is the inventor of patents used is a stimulus to work in research.'

It would be of interest if any of your readers could indicate whether the disadvantage noted by Dr Caldwell, of stifling the free interchange of ideas, has been found to be characteristic of the German system of directly linking successful industrial invention with rewarding the inventor, and also whether there is evidence of where the balance of advantage between the two conflicting principles may lie, either for the respective industries or for the individual chemists employed.

J. H. BENNITT

4 St Bernard's Road,
Solihull, Warwickshire

*Otto Horn, 'Chemical Research in Germany', *Research Management*, Spring 1961, **4**, 16.

OBITUARY

Vishnu Mahadeo Bhave. *B.* 17.2.08. *Ed.* Fergusson College, Poona, 1926–29; Ranade Industrial and Economic Institute, Poona, 1929–32. M.Sc., Ph.D. (Bombay). In 1933 he became an examiner in the Custom House, Bombay. In 1944 he left on his appointment as professor of organic chemistry at the Ramnarain Ruia College, Matunga, Bombay, a post which he held for the rest of his life. He rendered many services to the Indian perfumery industry, and held an important place in the academic world of Bombay as a leading lecturer in chemistry for post-graduate classes. He took a keen interest in the activities of the Western India Section of the Institute, which he served as a committee member and auditor for a number of years, and of the Bombay branch of the Indian Chemical Society. He was the author of papers in the scientific press. (*A.* 1942) *D.* 1.7.61.

Walter Blakey. *B.* 20.2.1887. *Ed.* Bradford Technical College, 1901–05. He was appointed a chemist at J. Crossley & Son, Halifax, in 1904, and later became laboratory and works chemist. He left in 1916 to take a post as a control chemist at H.M. Factory, Gretna. In 1919 he joined Brittains Ltd as chief chemist, and remained there until 1938, when he became a control and research chemist at Farina Dextrin Ltd. In 1940, he took a post as factory safety officer at the Royal Ordnance Factory, Pembrey, a position he held until his retirement. (*A.* 1919) *D.* 26.7.61.

Eric Draycott Catton. *B.* 28.12.1898. *Ed.* Hamond's School, Swaffham; University of Birmingham, 1919–23. B.Sc. In 1923 he took a post as assistant to the works manager of the Briton Ferry Chemical & Manure Co. Ltd. He left in 1926 on his appointment as a research chemist at Imperial Chemical Industries Ltd, Nobel Division. The following year he was transferred to the development department of Imperial Chemical Industries Ltd at their head office, where he remained for the rest of his life. (*A.* 1923, *F.* 1944) *D.* 22.8.61.

Edwin Jesse Fairhall. *B.* 24.11.1878. *Ed.* Central Technical College, South Kensington, London. In 1901 he joined A. Boake Roberts & Co. Ltd as an assistant chemist, and remained there until 1909, when he took a post as an analyst at James Robertson & Sons Ltd. The following year he was appointed to a similar position at Sparks, White & Co. Ltd. In 1913 he became chief chemist and technical manager of the International Tea Co.'s Stores Ltd. Later he was appointed chief chemist to Kearley & Tonge Ltd, a position which he held until his retirement. (*A.* 1904) *D.* 29.7.61.

Arthur James Fitch. *B.* 18.7.1880. *Ed.* Newport Grammar School; Finsbury Technical College, London, 1896–99. He joined the staff of Dr E. R. Mortiz in 1899, where he remained for nearly 15 years, becoming chief chemist. In 1914, he took a post as chief chemist and bacteriologist to Ind, Coope & Co. Ltd and three years later joined British Celanese Ltd. He left this country in 1923 to become manager of the Amcelle Plant, the parent unit of the Celanese Corporation of America. After his retirement he remained in America and became interested in horticulture. His annual display of some 16,000 plants was one of the seasonal attractions of the district where he had made his home. (*F.* 1918) *D.* 13.8.61.

John Charles Giblin. *B.* 18.2.1899. *Ed.* Taunton's School, Southampton; University College, Cardiff, 1919–21. B.Sc., Barrister-at-Law. In 1922 he became a science master at Christ College, Brecon. Some years later he took a similar post at the Royal Grammar School, Worcester. He remained there for the rest of his life, and at the time of his death was head of the science department. (*A.* 1955) *D.* 11.8.61.

John Mathie Glen. *B.* 14.12.16. *Ed.* Ardrossan Academy; University of Glasgow, 1935–39. B.Sc. He joined Rolls Royce Ltd as a research chemist in 1939. The following year, he took a post as a shift chemist at the Royal Ordnance Factory, Bishopton, later becoming a research chemist. In 1945 he was appointed a control officer with the Control Commission for Germany. On the termination of his duties in Germany in 1948, he returned to this country and joined Petrochemicals Ltd, firstly as a research chemist and later as a plant superintendent. At the time of his death he was engaged on operation planning for the Shell Chemical Co. Ltd. (*A.* 1948) *D.* 16.7.61.

Ronald Green. *B.* 5.9.27. *Ed.* Middlesbrough High School; Constantine Technical College, Middlesbrough, 1949–55. After serving two years in H.M. Forces, in 1948 he joined Imperial Chemical Industries Ltd, Billingham Division, as a laboratory assistant. During his service in the inorganic and exploratory research groups, he was progressively promoted to the grade of assistant technical officer. From 1959 until the time of his death he served as a committee member of the Tees-side Section of the Institute. (*A.* 1956) *D.* 21.7.61.

Robert Russell Hamilton. *B.* 21.5.1883. *Ed.* University of Glasgow, 1901–05, 1911–15. M.A., B.Sc. After graduating M.A. he became a teacher, returning to the University in 1911. Soon after the onset of the First World War, he joined the staff of Chance & Hunt Ltd, transferring in 1917 to British Dyes Ltd (now Imperial Chemical Industries Ltd). He left in 1922 to become managing partner in Stanford & Co. Ltd, manufacturing chemists, where he remained until his retirement. (*A.* 1917) *D.* 31.7.61.

Charles Alfred Hatton. *B.* 1.1.01. *Ed.* Manchester Central High School; Manchester College of Technology, 1918–21. M.Sc. Tech. In 1922 he joined Horrockses, Crewdson & Co. Ltd, Preston, as an assistant chemist. He remained with the same firm for the rest of his life and at the time of his death was works manager and chemist. (*A.* 1923) *D.* 27.8.61.

Samuel Henshaw. *B.* 6.1.1869. *Ed.* Merchant Venturers' Technical College, Bristol. He became an assistant to Dr E. W. Parnell in 1888. The following year he joined the Talk-o'-the-Hill Colliery Ltd as a chemist. In 1892 he was appointed chief chemist to the Staffordshire Chemical Co. Ltd, becoming manager and chief chemist in 1895 and managing director in 1907. From 1906 he acted also as consulting chemist to the Talk-o'-the-Hill Colliery Ltd, of which he became a director in 1913. His greatest achievement, however, was the creation of the National Benzole Co. Ltd, the formation of which in 1919 was in very large measure due to his initiative and energy. Just after the First World War, when the petroleum companies were well established, the benzole producers were unorganized and in isolation. Realizing that the demand for fuel for internal combustion engines was likely to develop very rapidly, Henshaw was able, through his drive and powers of persuasion, to prevail upon the benzole producers to get together and to set up their own marketing arrangements. The National Benzole Co. Ltd, of which he was the first chairman (a post which he held from 1919 to 1942), prospered continuously under his able guidance. (*F.* 1919) *D.* 6.8.61.

Stewart Roy Illingworth. *B.* 24.3.1886. *Ed.* Royal College of Science, London, 1907–11. D.Sc. In 1911 he became a temporary chemist at the Royal Arsenal, Woolwich, and the following year joined the Gas Lighting Improvement Co. Ltd as a chemist. In 1916 he became a lieutenant in the Royal Army Ordnance Department until 1918, when he was appointed head of the department of chemistry at the South Wales School of Mines, Treforest. He left in 1925 to become technical director of Illingworth Carbonisation Co. Ltd. Following a breakdown in health in 1938, he took a position as head of the science department at Denbighshire Technical College, a post which he held until his retirement in 1956. He had taken an active part in the North Wales Section of the Institute since its formation. (*A.* 1911, *F.* 1918) *D.* 10.8.61.

Ralph Francis Naylor. *B.* 22.8.21. *Ed.* Emanuel School, London; Imperial College of Science and Technology, London, 1939–42. B.Sc., Ph.D. On completion of a year's research in 1942, he took a post as a research chemist at the British Rubber Producers' Research Association. In 1949 he left this country on his appointment as lecturer in chemistry at Makerere College in Kampala, Uganda, where he remained until he was appointed to the Chair of Chemistry and Dean of the Faculty of Science at the newly-founded Royal College in Nairobi, Kenya, at the beginning of 1961. An organic chemist, his own research interests were centred on chemotherapy with special reference to leprosy, in which subject he had spent nine months' study at Harvard University as a Fulbright Scholar in 1953–54. He was a founder member of the East Africa Section of the Institute in 1956 and its first honorary secretary, continuing in office up to the time of his death. He took the work of organizing and reporting very

seriously and missed no opportunity of arranging meetings, excursions and visits. He had been president of the Uganda Amateur Athletic Association and in 1960 was elected president of the Uganda Mountain Club. He was the author of several scientific papers. 'In all his activities Ralph Naylor will be remembered as a man of deep religious convictions and of great enthusiasm, which inspired those who came in touch with him to activity themselves.' (*A.* 1942, *F.* 1950) *D.* 6.8.61.

William Harold Peters. *B.* 5.10.1879. *Ed.* University College, Nottingham, 1898–1901. For a short time in 1902 he was an assistant to the Nottingham City Analyst. Later that year he was appointed assistant chemist to Blundell, Spence & Co. Ltd, Hull, becoming head chemist the following year. He left in 1908 to join Dockers Bros Ltd as chief chemist. He remained with the same firm for the rest of his working life, becoming successively technical director, joint general manager and finally chairman. (*A.* 1902, *F.* 1905) *D.* 10.5.61.

William Leith Service. *B.* 28.11.12. *Ed.* Queen Mary College, 1930–33; Woolwich Polytechnic, 1933–34. B.Sc. He joined the Consett Iron Co. Ltd in 1935 as an analyst, becoming shift chemist in 1936 and senior analyst in 1939. He left in 1946 to take a post as assistant chief chemist at the Stanton Ironworks Co. Ltd. In 1949 he was appointed technical records officer at the Ministry of Supply and in 1951 became a production chemist in the United Kingdom Atomic Energy Authority. In 1956 he was transferred to the Dounreay Experimental Reactor Establishment as operations manager of the chemical plant, a post which he held for the rest of his life. (*A.* 1953) *D.* 3.5.61.

Norman Sheldon. *B.* 28.9.1891. *Ed.* Heversham Grammar School; Royal College of Science, London, 1911–14. He became a research chemist at H.M. Factory, Oldbury, in 1915, and three years later took a similar post at the United Steel Companies Ltd. In 1923 he joined Duroglass Ltd as a chemist. In 1925 he became technical and advisory chemist to the Worcester Royal Porcelain Co. Ltd and John Moncrieff Ltd, and for 36 years continued to take an active part in the management of both companies, up to the time of his death. For many years he was chairman of the British Chemical Ware Manufacturers' Association. He was also vice-president of the British Association of Chemists and a leading member of the Glass Manufacturers' Federation. He served as a member of Twickenham Borough Council from 1946 and of Middlesex County Council from 1958. He established a reputation as a tough, uncompromising and independent-minded councillor. 'A man of independent outlook, he would not conform or be tied by . . . rules.' (*A.* 1917, *F.* 1942) D. 18.7.61.

THE REGISTER

NEW FELLOW

(A) BURNETT, Prof. George Murray, B.SC., PH.D.(ABERD.), PH.D., D.SC.(BIRM.)

ASSOCIATES ELECTED TO THE FELLOWSHIP

(Q) BOND, Joan, B.SC., PH.D.(BRIST.)
(P) CHISMAN, Dennis Geoffrey, B.SC.(LOND.)
COLLINS, Dorothy Ada, M.SC.(LIV.)
(D) GARDINER, Stanley James, M.SC.(LOND.)
(S) GELLNER, John George, B.SC.(DURH.)
(V) HALLAM, Harry Evans, M.SC.(WALES), PH.D.(LOND.)
(P) HAMMOND, Edgar, B.SC.(LOND.), A.R.C.S.
HEACOCK, Ronald Arthur, B.SC., PH.D.(LOND.)
(D) MACKAY, Eric John, A.M.I.CHEM.E.
(A) MOSER, Wolfgang, B.SC.(LOND.)
(C) ROBINSON, Ronald, B.SC., PH.D.(LOND.), A.R.T.C.S.
(H) TIMMONS, Christopher John, B.SC., PH.D.(LOND.), A.R.C.S., D.I.C.

NEW ASSOCIATES

(Q) BOTTOMLEY, Gordon, B.SC.(LOND.)
(P) COOLEY, George, M.SC.(LOND.)
(R) DANCE, John David, B.SC.(S'TON)
DENYSSCHEN, Johannes Hendrikus, B.SC.(S.A.), M.SC.(POTCHEF.)
(OJ) FERNANDO, Mihindukulasuriya Jonas, M.SC.(CEYL.)
(V) GIBBON, Brian Arthur, B.SC.(WALES)
HESTER, Ronald Ernest, B.SC.(LOND.)
(R) HILL, Roger Leonard, B.SC.(LOND.)
(C) JAGGER, Anthony Hainsworth, B.SC., PH.D.(MANC.)
(E) JONES, Edward Barry, B.SC.(WALES)
(A) MCCOLM, Ian John, B.SC.(MANC.)
(Q) MAINSTONE, John Howard, B.A.(OXON.)
(P) MARKHAM, Edward, B.SC., PH.D.(NOTT.)
(N) RICHARDSON, Douglas Turnbull
(R) ROCKETT, Bernard William, B.SC.(S'TON)
(V) RODERICK, Howell Rhys
(OJ) RODRIGO, Seetha Indrani, B.SC.(CEYL.)
(SS) ROXBURGH, Douglas, B.SC.(GLAS.), A.R.C.S.T.
(N) SCROWSTON, Richard Michael, B.SC.(LEEDS)
(S) TURNER, Denys Grahame, B.SC.(LOND.)
(P) WREN, John Josiah, M.A., PH.D.(CANTAB.)

GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

(Q) BLACKBURN, James Alan
(M) BROWN, Frankland
(O) BURBIDGE, Peter Alderson
(P) BURTON, James Sidney, B.SC.(LOND.)
(P) CHAPPELL, Ronald Arthur Charles
(R) GRAVES, Brian Alan
(P) HEINEMANN, Brigitte, B.SC.(LOND.)
(L) HEMINGWAY, Eric
(C) HUGHES, Charles Henry
(J) MILLAR, Andrew Scott, A.H.-W.C.
(Q) MOLYNEUX, Alan, A.R.T.C.S.
(U) NIXON, Leslie Arthur
(Q) NIXON, Norbert, A.R.T.C.S.
(Y) O'BRIEN, Kevin Bernard
OTISI, Agwu Otisi Agwu, A.R.C.S.T.(GLAS.), D.I.C.
PEARSON, Barry Douglas, B.SC., PH.D.(LOND.)
(P) RANDERSON, Michael John, B.SC.(MANC.), DIP.CHEM.ENG.
(A) REID, John
(J) SEDDON, William Arthur
(P) SKRIMSHIRE, Anthony John Hamor
(P) SMITH, John Royston
(M) STEELE, John Malcolm
(O) TAYLOR, Robert
(K) TAYLOR, Robert Bannatyne, B.SC.(GLAS.), A.R.C.S.T.
(K) WATTS, William Edward, B.SC.(GLAS.), A.R.C.S.T.
(V) WEATHERSTON, John, M.SC.(WALES), A.R.C.S.T.

NEW GRADUATE MEMBERS

(O) ALLEN, Malcolm George
(C) ALLSOP, John Cecil
(S) ATKINSON, Geoffrey
(P) BAKER, Paul James
(Y) BARNETT, John Edward Gordon, B.A.(OXON.)
(P) BAYS, David Edmund
(G) BENNETT, David, B.SC.(BRIST.)
(P) BERRY, Edwin Enfield
(O) BEVAN, Geoffrey
(X) BROWN, Valerie
(FF) CAMERON, Euan Hamish Donaldson, B.SC.(ST AND.)
(Q) CHRISTIAN, John Roland
(P) COATS, Anthony William, B.SC.(LOND.)
(P) COTTON, John William
(Y) CROZIER, Brian, B.SC.(BRIST.)
(D) DAVIES, Richard Llewelyn, B.SC.(BRIST.)
(P) DEALTRY, Christopher Edward
(K) DUMBRECK, Adam Charles
(E) EVANS, Jeffrey Cuthbert, B.SC.(WALES)
(P) GRIFFIN, Gabrielle, B.SC.(MANC.)
(P) HALES, Leonard Austin Winser, B.SC.(LOND.)
(FF) HANSON, Peter, B.SC. (ST AND.)
(P) HARRAP, Kenneth Reginald, B.SC., PH.D.(LOND.)
(O) HESLAM, Robin Snell
(P) HILLS, Ian Richard

(N) HOPKINSON, John Walter
(O) HUGHES, Ernest John
(P) JACKSON, Brian Malcolm Banks
(N) JENKINS, Edgar William, B.SC.(LEEDS)
(M) JOHNSON, Peter
(O) JONES, Edward Owen
(J) JONES, George Smillie, A.H.-W.C.
(P) KILLOH, David Charles
(P) LAMBERT, Hugh Richmond, B.A.(CANTAB.)
(P) LAWRENCE, Brian Edward, B.SC.(LOND.), A.R.C.S.
(O) LEE, Brian Edward, B.SC.(LIV.)
(P) LUFF, Norman Albert Julius
(O) LYNES, Albert
(P) McINTOSH, Brian Dudley
(SS) MALLINSON, John Hirst, B.A.(OXON.)
(Y) MARSDEN, John Christopher, B.A.(OXON.)
(P) MILLS, Richard John
(Y) MONAHAN, James
(H) MOORE, Frank Eric
(P) MUNN, Peter William, B.SC.(BRIST.)
(P) NICOLSON, Norman Derek
(O) OXLEY, Charles Edward
(W) PARKER, Vernon, B.SC.(LOND.)
(O) PATTISON, William Arthur
(H) PEARCE, Anthony Arthur, B.SC.(LOND.)
(WW) PEARSON, George Graham, B.SC.(ST AND.)
(K) PHILP, John
(O) PODMORE, John
(P) REID, John Glen, B.SC.(BRIST.)
(N) REILLY, Brennan Michael
(J) RIDDELL, William, A.H.-W.C.
(P) RIXSON, Alan Gerald
(P) SCOTLAND, William West Frederick
(P) SHADBOLT, Roy Stanley
(P) SKUJINS, Sigurds
(C) SMITH, Keith Martin
(D) SMITH, Paul Anthony, B.SC.(LIV.)
(P) SPERRIN, Alan David
(P) SWIFT, Graham, B.SC.(LOND.)
(C) TABNER, Brian James, B.SC.(WALES)
(O) TIVNANN, Richard Fife
(D) TUNNELL, David Alan
(P) VINCENT, Alan, B.SC.(LOND.)
(L) WALSHAW, Keith Beverley, B.A.(OXON.)
(P) WARREN, Brian Thomas, B.SC.(LOND.)
(M) WILLIAMS, Peter
(X) WRIGHT, Henry Glyn
(E) WYNNE, Richard Alun John, B.SC.(WALES)

DEATHS

Fellows

(K) ANDREW, George William, M.SC.(MANC.). Died 30 October, 1961, aged 76. *F.* 1918.

(P) DE LACY, Sidney Augustus. Died 16 October, 1961, aged 69. *A.* 1919, *F.* 1933.

(U) GREGORY, Edwin, M.SC., PH.D.(LOND.), A.MET.(SHEFF.). Died 7 November, 1961, aged 66. *A.* 1928, *F.* 1931.

(P) KENYON, Joseph, D.SC.(LOND.), F.R.S. Died 12 November, 1961, aged 76. *A.* 1908, *F.* 1911.

(Q) MADDOCKS, John Robert. Died 23 October, 1961, aged 61. *A.* 1930, *F.* 1943.

(X) WATSON, James, D.SC. (DURH.). Died 17 November, 1961, aged 84. *F.* 1917.

(P) WILLIAMS, Ewart Harrod, M.B.E., B.SC.(LOND.). Died 25 October, 1961, aged 62. *A.* 1920, *F.* 1939.

Associates

(Q) BURNS, Herman Morrison, M.SC.TECH.(MANC.). Died 8 October, 1961, aged 58. *A.* 1938.

(H) EARLY, Geoffrey Ingham. Died 20 October, 1961, aged 33. *A.* 1953.

(P) STANESBY, Cecil Howard. Died 20 October, 1961, aged 53. *A.* 1948.

Graduate Member

(K) WILLIAMSON, Joseph Maclean. Died 18 September, 1961, aged 23.

LOCAL SECTIONS DIARY

Sections are glad to welcome members of other Sections to their meetings and social functions, except when numbers are restricted, as for works visits. Those wishing to attend meetings outside their own area are advised to write to the Hon. Secretary of the Section concerned, as the Institute cannot accept responsibility for any alterations or cancellations. All times are p.m. except where otherwise stated. For key to Local Sections *see J.*, 386.

(A) **Aberdeen.** 29 Dec. 3. Christmas Lecture. Dr P. M. B. Walker. Chemistry Department, Old Aberdeen. Joint, C.S. and S.C.I.

——10 Jan. Precision Balances: History, Development and Techniques. (With film,) A. O. Brooks. Chemistry Department, The University. Joint, C.S. and S.C.I

(B) **Belfast.** 2 Jan. 3. Lecture and Demonstration for Schools: Colour Photography. Dr R. W. G. Hunt. Chemistry Lecture Theatre, Queen's University.

(C) **Birmingham.** 16 Jan. 6.30. Non-Benzenoid Aromatic Hydrocarbons. Dr J. F. W. McOmie. College of Technology, Gosta Green

(D) **Bristol.** 11 Jan. 6.30. Forensic Chemistry. Dr F. D. M. Hocking. Chemistry Department, The University, Woodland Road

(P) **Cambridge.** 26 Jan. 8.30. Colour Photography. A. W. Yates. University Chemical Laboratory, Lensfield Road. Joint, University Chem. Soc.

(E) **Cardiff.** 26 Jan. 7. Ladies' Evening: Cosmetics. Queen's Hotel. Joint, S.C.I.

(H) **Derby.** 16 Jan. 7.30. Some Aspects of the Work of a Public Analyst. R. W. Sutton. Derby and District College of Technology, Kedleston Road

(F) **Dublin.** 24 Jan. 'Genesis.' Prof. B. Spencer. University College

(FF) **Dundee.** 20 Dec. 3. Christmas Lecture for Senior Pupils: Vitamins. Dr M. A. Pyke. Queen's College

19 Jan. 7.15. Educational Symposium. Technical College, Bell Street

(J) **Edinburgh.** 18 Jan. 7.30. Recent Advances in the Chemistry and Applications of Silicones. Dr J. Stafford. Heriot-Watt College, Chamber Street. Joint, C.S. and S.C.I.

(P) **Enfield.** 22 Jan. 7. The Role of Chemistry in Mineral Processing Dr A. J. Robinson. Technical College, Queensway, Ponders End

(W) **Exeter.** 19 Jan. 5.15. The Metallurgy of the Copper and Bronze Ages. Dr F. C. Thompson. Washington Singer Laboratories

(K) **Glasgow.** 12 Jan. 7. Film Show. Royal College of Science and Technology. Joint, S.C.I.

(M) **Hull.** 6 Jan. 10 a.m. Symposium on Recent Advances in some Instrumental Methods of Analysis. Physics Department, The University

—— 15 Jan. 7.30. Selection and Training for Management in the Chemical Industry. J. E. V. Tyzak. Chemistry Department, The University. Joint, I.W.M.

(C) **Keele.** 9 Jan. Polymers from Olefin Oxides. Prof. G. Gee. University College of North Staffs.

(N) **Leeds.** 22 Jan. 6.30. Some Horizons in Physical Chemistry. Prof. F. S. Dainton. Chemistry Lecture Theatre, The University

(O) **Liverpool.** 1 Feb. 7. Ubiquinones and Related Substances. Prof. R. A. Morton. Donnan Laboratories, The University, Vine Street

(P) **London.** 17 Jan. 7. Sixth Ladies' Evening: Chemistry in Horticulture and the Garden. Dr E. Holmes. Science Museum, S.W.7

(Q) **Manchester.** 4 Jan. 7. Annual General Meeting, followed by talk: Education of the Industrial Chemist. Dr N. Booth. Manchester Literary and Philosophical Society, 36 George Street

(S) **Newcastle.** 10 Jan. 6.30. Something Old, Something New. Prof. R. N. Haszeldine. Chemistry Department, King's College

(R) **Portsmouth.** 26 Jan. 7. Reactions of Highly-Excited Molecules. Dr H. M. Frey. College of Technology. Joint, Portsmouth and District Chem. Soc.

(SS) **Preston.** 26 Jan, 3; 27 Jan, 10.30 a.m. Lecture and Demonstration for Sixth-Form Science Students: Explosives. Col B. D. Shaw. Catholic College Hall, Chapel Street

(Y) **Reading.** 12 Jan. 6.30. Ladies' Evening: Frozen Food (J. Lyons & Co. Ltd). Heelas's Restaurant

(EE) **Seascale.** 24 Jan. 8. Ion Exchange: An Industrial Process. Dr V. E. Gripp. Windscale Club

(P) **Slough.** 24 Jan. 7.30. Polymers of Phosphorus and Nitrogen. Dr R. A. Shaw. College of Further Education, William Street. Joint, College Sci. Soc.

(V) **Swansea.** 12 Jan. 6. The Production and Properties of Some of the Newer Metals. Dr N. P. Inglis. Chemistry Department, University College

INDEX: 1961

Aberdeen and North of Scotland Section, 59, 106, 187, 447
  Annual General Meeting, 281
Achema, 1961, 117
Advisory Council on Education for Management, 23, 58
Agricultural Science, School in, 118
'Alkali Acts and Their Application, The,' 260
American Chemical Society, 349
Analysis of Metals, Symposium on, 152
Analytical Chemistry, Horizons in, 155
Analytical Chemistry, Society for, *see* Society for Analytical Chemistry
Anderson Committee Report, 79
Angewandte Chemie, 359
Annual Conference, 1961, 22, 207
  1962, 408
Annual General Meeting, Eighty-Third, 55, 103, 182, 211
Antarctic Expeditions, Scientists for, 204
Apothecaries, Society of, *see* Society of Apothecaries of London
Approved Names, 36, 88, 287, 423
Art in Roman Britain, Exhibition of, 202
Arts Chimiques, Conférence Internationale des, 117
Associates Elected to the Fellowship, 37, 77, 123, 159, 254, 289, 319, 426, 467
Association of British Chemical Manufacturers, 119
Association of Clinical Biochemists, 412
Association of Consulting Scientists, 226
Association of Public Analysts, 279
Association of Women Science Teachers, 119
Awards, 71, 145, 152, 315, 382, 420, *see* also Honours and Awards

'Bacteria, Chemical Reaction Sequences in,' 393
Bayles, D. A., *see* Hallett, L. H. W.
Beilby Medal and Prize, 146, 224, 277
Beit Fellowships for Scientific Research, 420
Belfast and District Section, 59, 148, 416, 447
  Annual General Meeting, 187
  Presentation to Dr Honneyman, 146
Benevolent Fund's Object, Extension of, 337
Bickley, W. G., 'Science for the Blind,' 321
Binding of Institute Publications, 104, 183
Biochemical Society, 72
Biochemistry of Fats, Symposium on, 153
Birmingham and Midlands Section, 25, 187, 447
  Spring Lecture Course, 55
  Annual General Meeting, 187
  Dr Newton Friend Celebration Dinner, 183, 278
Birthday Honours, 271
'Blind, Science for the,' 321
Book Reviews, 12, 48, 92, 137, 175, 222, 267, 303, 331, 360, 400, 435
Bottle, R. T., 'Current Instruction in the Use of Chemical Literature,' 173
Bristol and District Section, 60, 106, 188, 236, 281, 448
  Annual General Meeting, 60
British Association for the Advancement of Science, 203, 383
'British Chemical Industry, The,'
  Part I, 5
  Part II, 40
British Coking Industry, 420
British Society of Rheology, 73
British Standards Institution, 339
British United Provident Association Group Scheme, 359
Britton Memorial Lecture, 445
Bryant, K. C., 'New Methods of Polymerization,' 323
By-Laws of the Institute, Changes in the, 336

Caldwell, W. A., 'Some Thoughts on Research and Development,' 354
Canada, Chemical Institute of, *see* Chemical Institute of Canada
Cape Section, 379
  Annual General Meeting, 285
Carbohydrate Chemistry, International Symposium on, 286
Cardiff and District Section, 107, 282, 416, 449
  Annual General Meeting, 282
'Careers Master, Industry and the,' 81
'Catalysts for Progress,' 163
Ceylon Section, 68, 199, 312
  Annual General Meeting, 69
Chemical Age Directory and Who's Who, 119
Chemical Engineering Exhibition, 346
Chemical Engineering, Summer School in, 249
Chemical Engineering, Third Congress of the European Federation of, 203
Chemical Engineers, Institution of, *see* Institution of Chemical Engineers
Chemical Industry, Society of, *see* Society of Chemical Industry
Chemical Institute of Canada, 72, 117, 153, 286
Chemical Machinery, Chemical Engineering and Automation, Congress on, 463
'Chemical Reaction Sequences in Bacteria.Some Recent Discoveries,' 393
Chemical Society, 72, 203, 315
  Library, 56, 120, 376, 445
Chemicals from Petroleum, Symposium on, 209
  Published Papers, 293, 323
'Chemistry at the Science Museum,' 126
Chemistry Course for Teachers, 221
Chemistry in the Service of Medicine, Congress on, 286
'Chemistry Syllabus, Suggested Changes in the,' 2
Ciba Foundation Annual Lecture, 382
Clean Air, National Society for, *see* National Society for Clean Air
Clean Air Year Book, 287
Clinical Biochemists, Association of, *see* Association of Clinical Biochemists
Colour Group, 72, 204, 382, 423
Combustion Research Colloquia, 35
Committee Members, 229
Committee on Higher Education, 387
Commonwealth Technical Training Week, 74
Conference of Local Section Hon. Secretaries, 234, 414
Conferences, Forthcoming International Scientific and Technical, 35
Consultants, 24, 56, 146
Consulting Scientists, Association of, *see* Association of Consulting Scientists
Corday-Morgan Medal and Prize, 152
Correspondence, 36, 75, 120, 156, 205, 251, 288, 317, 350, 383, 424, 465
Corrosion, Course on, 71
Corrosion Group Essay Competition, 71
Corrosion, Summer School on, 315
Cosmetic Industry, Packaging in the, Symposium on, 250
Cosmetic Science, International Congress of, 117
Coulson, E. H., 'Planned School Science,' 161
Council Members, 186, 214, 228
Courses, 35, 71, 152, 202, 249, 315, 346, 382
Courses for Teachers, 118, 221, 300
Cumberland and District Section, 25, 188, 236, 310, 417
  Annual General Meeting, 237
'Current Instruction in the Use of Chemical Literature,' 173

Dagley, S., 'Chemical Reaction Sequences in Bacteria,' 393
Damon, W. A., 'The Alkali Acts and Their Application,' 260
Davies, L., 'Hydrogen and the Periodic Table,' 430
Davies, N. H., 'Infra-Red Spectroscopy for Undergraduates,' 301
Deaths, 38, 77, 124, 160, 206, 254, 290, 320, 352, 385, 428, 468
Deccan Section, 69, 246, 285, 313, 345, 380, 462
  Annual General Meeting, 199, 246
Dechema, 117, 154
Diary of Meetings of Local Sections, *see* Local Sections Diary
Diffusion and Mass Transport in Solids, Conference on, 421
Dip. Tech. Courses, 118
Diploma Examinations in Applied Chemistry, 145, 277, 306, 408, 443
Directory of Independent Consultants, 375, 444
District Members of Council, 22, 186, 228, 375
D.S.I.R. Awards, 73
Dublin and District Section, 26
Dundee and District Section, 26, 61, 107
  Annual General Meeting, 282
Dyers and Colourists, Society of, *see* Society of Dyers and Colourists

East Africa Section, 33, 314, 345
  Sixth Annual Conference, 200
East Anglia Section, 61, 108, 188, 237, 343, 417
  Annual General Meeting, 450
East Midlands Section, 108, 189, 282, 450
  Annual General Meeting, 189
Eastern India Section, 202, 345, 381
  Annual General Meeting, 419
Edinburgh and East of Scotland Section, 108, 189, 451
  Annual General Meeting, 189
Education Committee, 55
Education for Management, Advisory Council on, 23, 58
Effluent and Water Treatment Exhibition, 346
Endeavour Prizes, 71
Examinations for Graduate Membership, *see* Graduate Membership Examinations
Examiners 1961, 229
Exhibitions, 71, 152, 202, 249, 286, 346, 420

Faraday Society, 72, 117, 315
Fat Research, International Society for, *see* International Society for Fat Research
Feigl Anniversary Symposium, 249, 421
'Fibres from Polypropylene,' 293
Film Index, *see Index of Chemistry Films*
Food Science and Technology, First International Congress of, 286
Food Science, Degree Courses in, 346
'Food Technologists, Supply and Training of,' 429
Food Technology, First European Symposium on, 249, 287, 464
'Foodstuffs, Agricultural Pesticides and Chemistry,' 89
'For Students, Parents and Teachers,' 79
Freeze-Drying of Foodstuffs, Symposium on, 249, 346
'Fuel Cell, Sir William Robert Grove (1811-1896) and the Origins of the,' 291
Fuel, Institute of, *see* Institute of Fuel

Gas Chromatography, Fourth International Symposium on, 249
General Members of Council, 182, 186, 215, 228, 442
Geographical Index to the *Register*, 444
Germany, Study-Tour in, 288
Glasgow and West of Scotland Section, 109, 148, 283, 310
  Annual General Meeting, 237
  Exhibition of Laboratory Apparatus, 307, 417
  Retiring Chairman's Address, 354
Gmelins Handbuch, 250
Graduate Members Elected to the Associateship, 37, 77, 123, 160, 254, 290, 320, 426, 467
Graduate Membership Examinations,
  January, 1961, 102
  April, 1961, 224
  June, 1961, 102, 145, 338
  September, 1961, 145, 182, 408
  January, 1962, 338, 375
  April, 1962, 408, 442
  Pass Lists, 102, 224, 339, 408
'Grammar School Chemistry,' 1
Greenaway, F., 'Chemistry at the Science Museum,' 126
'Grove, Sir William Robert (1811-1896), and the Origins of the Fuel Cell,' 291

Hallett, L. H. W., 'Productivity in Practical Organic Chemistry,' 45
Harkness Fellowships, 382
Harrison Memorial Prize, 1959, 12
Health Physics, Summer School in, 202
Henderson Memorial Lecture, 278
Herbert, E. Le Q., 'Catalysts for Progress,' 163
High Polymer Research Group, 35
Higher Education, Committee on, 387
Hon. Representatives in Universities, 231, 410, 411
Hon. Secretaries of Local Sections, 78, 233, 386
  Conference of, *see*, Conference of Local Section Hon. Secretaries
Hong Kong, University of, 203
Honours and Awards, 23, 56, 104, 183, 225, 271, 307, 339, 411
Huddersfield Section, 27, 109, 149, 190, 451
  Annual General Meeting, 190
Hull and District Section, 61, 109,1 49, 190, 238, 417, 451
  Symposium on Instrumental Methods of Analysis, 463
'Hydrogen and the Periodic Table,' 430

I.C.I., 25, 92, 156, 205, 316
Index of Chemistry Films, 103
Industrial Chemistry, International Congress of, 117
Industrial Safety, Postgraduate Course in, 249
Industrial Water and Effluents Group of the S.C.I., 421
'Industry and the Careers Master,' 81
'Infra-Red Spectroscopy for Undergraduates,' 301
'Inorganic Chemistry at Pre-University Level, The Teaching of,' 217
Inorganic Chemistry in National Certificate and Diploma Courses, A Conference on, 216
Inorganic Chemistry, Symposium on the Teaching of, 409
Inorganic Polymers, Symposium on, 153
Insecticide and Fungicide Conference, 117, 203
Institute Affairs, 22, 55, 102, 145, 182, 224, 277, 306, 336, 375, 408, 442
Institute of Fuel, 146
Institute of Metal Finishing, 153
Institute of Metals, 204

Institute of Physics and the Physical Society, 117, 119, 203, 315, 316, 421
Presidential Address, 204
Annual Exhibition, 463
Institute of the Rubber Industry, 118
Institution of Chemical Engineers, 72, 340
Institution of Metallurgists, 204
Instrumental Methods of Analysis, Symposium on, 463
International Palladium Medal, 152
International Society for Fat Research, 203, 315, 421
Ionosphere, Conference on the, 421
Iron and Steel Institute, 204, 421
IUPAC, 117, 315

Johnson, W. C., 'Manufacture and Control of Laboratory Chemicals,' 257
Joint Library Committee, 23, 443

Labelling Procedure for Compounded Medicinal Preparations, 88
Laboratory Apparatus and Materials Exhibition, 152, 249
Laboratory Apparatus and Techniques, Manchester Exhibition of, 263
Laboratory Apparatus Exhibition, 286
'Laboratory Chemicals, Manufacture and Control of,' 257
Laboratory Risks and Safeguards, Correspondence on, 37, 120, 252
'Learning Physical Chemistry by Experiment,' 255
Lecture Series 1961, 56, 307
Errata, 411
Lectures, Monographs and Reports, *see* also *Lecture Series* 56
Leeds Area Section, 190, 238
Annual General Meeting, 27, 452
Leisten, J. A., 'Learning Physical Chemistry by Experiment,' 255
Lending Library Unit, 250
Lessing, Rudolf, 'Recollections of Raphael Meldola,' 353
Leverhulme Research Awards, 271
Lewis, D. T., 'Foodstuffs, Agricultural Pesticides and Chemistry,' 89
Liaison Officers in Technical Colleges, 23, 55, 146, 232, 306, 411
Fourth National Conference of, 306
Licentiateship, 55, 66, 103, 146, 213, 224, 306, 337, 414, 444
Life Membership Fees, 443
'Literature, Current Instruction in the Use of Chemical,' 173
Liverpool and North-Western Section, 62, 191, 239, 453
Symposium on the Teaching of Inorganic Chemistry, 23, 71, 104, 217
Annual General Meeting, 239
Local Section Hon. Secretaries, *see* Hon. Secretaries of Local Sections
Local Sections Diary, 38, 78, 124, 160, 352, 386, 428, 468
London Section, 28, 63, 110, 192, 240, 283, 310, 343, 378, 417, 454
Symposium on Soil Problems, 55, 168
Annual General Meeting, 63
Public Lecture, 58, 194

Madras Section, 150, 248, 313, 463
Annual General Meeting, 115
Malaya Section, 116
Annual General Meeting, 116
Management of Research, Seminar on, 464
Manchester and District Section, 65, 194, 244, 344, 378, 418, 458
Annual General Meeting, 66
Exhibition of Laboratory Apparatus and Techniques, 263
Man-Made Fibres, World Congress of, 421
'Manufacture and Control of Laboratory Chemicals, 257
Mass Spectrometry Conference, 35
Meetings and Conferences, 35, 72, 117 152, 203, 249, 286, 315, 346, 382, 421
Meldola Medal, 1960, 145, 182, 376, 443
1961, 376
'Meldola, Raphael, Recollections of,' 353
Metal Finishing, Institute of, *see* Institute of Metal Finishing
Metallic Corrosion, International Congress on, 118
Metallurgists, Institution of, *see* Institution of Metallurgists
Metals, Institute of, *see* Institute of Metals
Microbiology, International Congress for, 287
Microchemical Techniques, International Symposium on, 35
Mid-Southern Counties Section, 29, 66, 113, 149, 196, 245, 418, 458
Annual General Meeting, 284
Symposium on the Teaching of Inorganic Chemistry, 409

National Coal Board, 420
National College of Agricultural Engineering, 316
National College of Food Technology, 36
National Council for Technological Awards, 347
National Lending Library, 250, 359
National Society for Clean Air, 250, 382
New Associates, 37, 77, 123, 159, 254, 290, 320, 426, 467
New Fellows, 37, 77, 123, 159, 254, 289, 319, 426, 467
New Graduate Members, 38, 77, 124, 160, 254, 290, 320, 427, 467
'New Methods of Polymerization,' 323
New Year Honours, 23
Newcastle upon Tyne and North-East Coast Section, 30, 113, 460
News and Notes, 35, 71, 117, 152, 202, 249, 286, 315, 346, 382, 420, 463
News of Hon. Fellows, 56, 183, 271, 307, 376, 445
Nigeria, Proposed Local Section in, 444
North Lancashire Section, 66, 344, 419
North Wales Section, 30, 461
Nuclear Magnetic Resonance Spectroscopy, Symposium on, 35
Nuclear Science, Courses in, 315
Nuclear Technology, Course in, 152

Obituary, 76, 121, 158, 206, 253, 289, 319, 351, 385, 425, 466
O.E.E.C., 347, 464
Officers and Members of Council, 186, 214, 228
Oil and Colour Chemists' Association, 72, 286, 420
Oil Consumption, U.K., 288
'Organic Chemistry, Productivity in Practical,' 45
Organometallic Compounds, 119, 205
Oversea Candidates: Assessment Fees, 443
Oxidation Processes, Symposium on, 347

Paper, Symposium on Formation and Structure of, 73
Perkin Centenary Trust, 420
Personal Notes, 23, 56, 104, 146, 183, 225, 271, 307, 339, 376, 411, 445
Petroleum, Symposium on Chemicals from, *see* Chemicals from Petroleum
'Physical Chemistry by Experiment, Learning,' 255
Physical Society, *see* Institute of Physics and the Physical Society
Physics of Semiconductors, Conference on, 347
Physics, Institute of, *see* Institute of Physics and the Physical Society
'Planned School Science,' 161
Plastics, Engineering with Conference on, 382
Plastics Exhibition, 152, 249
Plastics Industry, Safety in the, Course on, 382
Plastics Institute, 118, 153, 287, 422
Polarographic Society, 347
Polymer Science, Symposium on the Techniques of, 347
'Polymerization, New Methods of,' 323
Polymers of the 1960s, Symposium on, 287
'Polypropylene, Fibres from,' 293
President Designate, 22
'President, Our New,' 125
Presidential Address: 'Catalysts for Progress,' 163
'Productivity in Practical Organic Chemistry,' 45
P.S.A.B. Convention, 74
Public Analysts, Association of, *see* Association of Public Analysts
Public Schools Appointments Bureau, *see* P.S.A.B.
Publications Received, 21, 54, 144, 181, 223, 276, 305, 407
Pure and Applied Chemistry, 18th International Congress of, 73, 117
Pure Food Centenary, 156

Radiation Safeguards, 287
Radiation Safety Practice, Examinations on, 349
Radio Spectroscopy of Solids, Conference on, 203
Radiochemistry, Course on, 152
Radiological Units and Measurements, International Commission on, 154
'Raman Spectra,'
Part I, 83
Part II, 132
Ramsay Memorial Fellowship, 118
Rare-Earth Metals, 287
Reactor Fuel Element Technology, a Course on, 152
Recent Publications, 119, 154, 204, 250, 287, 348, 422
Recognition of Colleges, 146, 411
'Recollections of Raphael Meldola,' 353
Register, The, 37, 77, 123, 159, 206, 254, 289, 319, 352, 385, 426, 467
Register of Fellows and Associates, 103, 342
Representatives of the Institute on Other Bodies, 55, 104, 145, 183, 230, 281, 307, 339, 410
'Research and Development, Some Thoughts on,' 354
Research, Seminar on the Management of, 464
Retirements, 105, 185, 227, 281, 309, 342, 377, 446
Rheology, British Society of, *see* British Society of Rheology
Robbins Committee, 387
Rose, J., 'Raman Spectra,' 83, 132
Rothery, E. J., 'Suggested Changes in the Chemistry Syllabus,' 2
Royal Automobile Club Group Scheme, 55, 359
Royal Institution, 203
Royal Society, 24, 146, 423
Royal Society of Edinburgh, 445
Rubber Industry, Institute of, *see* Institute of the Rubber Industry

Scholarships Abroad 1961-62, 73
'School Science, Planned,' 161
'Science for the Blind,' 321
Science Masters' Association, 1, 118
'Science Museum, Chemistry at the,' 126
Scientific Film Association, 424
Secretary and Registrar, 442
Section Activities, 25, 59, 106, 148, 187, 236, 281, 310, 343, 378, 416, 447
Sheffield, South Yorkshire and North Midlands Section, 66, 196
'Sir William Robert Grove (1811-1896) and the Origins of the Fuel Cell, 291
'Smithson Tennant, 1761-1815,' 432
Societies and Institutions, 24, 56, 104, 146, 184, 226, 279, 307, 376, 411, 445
Society for Analytical Chemistry, 73, 153, 155
Society for Water Treatment and Examination, 73, 347
Society of Apothecaries of London, 286
Society of Chemical Industry, 118, 153, 184, 203, 349
Society of Dyers and Colourists, 316
'Soil: Problems Raised by its Use and Misuse, The,' 168
Soil Problems, Symposium on, 55
'Some Thoughts on Research and Development,' 354
South African Chemical Institute, 287
South Wales Section, 30, 461
South-Western Counties Section, 31, 245, 462
Soviet Science and Technology, News of, 350
Soviet Technology Digest, 154
Space Technology Materials, Symposium on, 422
Space Technology, Symposium on, 250
Spectra Index, National, 422
'Spectroscopy for Undergraduates, Infra-Red,' 301
Spectroscopy, Symposium on, 316
Stirlingshire and District Section, 67, 114
Annual General Meeting, 246
Students Elected to the Associateship, 124, 428
Sugar, Industrial Uses of, 464
'Suggested Changes in the Chemistry Syllabus,' 2
Summer School in Analytical Chemistry, 1962, 22, 409
Summer School in Physical Chemistry, 35
Summer School on Corrosion, 315
'Supply and Training of Food Technologists,' 429

Tablet and Capsule Identification Guide, 88
Teachers, Courses for, 118, 221, 300
'Teaching of Inorganic Chemistry at Pre-University Level, The,' 217
Teaching of Inorganic Chemistry, Symposium on, 409
Technical Authorship, 73
'Technical Training Moves Ahead,' 39
Technicians in the Chemical Industry, 155
Tees-Side Section, 67, 115, 196
Annual General Meeting, 419
'Tennant, Smithson, 1761-1815,' 432
Textile Institute, 118
Thames Valley Section, 32, 68, 197
Annual General Meeting, 32, 198
Thomas, C. J., 'The British Chemical Industry,' 5, 40
Thomas, Sir Miles, 'Industry and the Careers Master,' 81
Thompson, A. B., 'Fibres from Polypropylene,' 293
Times, The: Reduced Rate for Students, 56

'Undergraduates, Infra-Red Spectroscopy for,' 301
University Grants Committee Report, 392

Vacuum Science and Technology, Symposium on, 347
Vice-Presidents of the Institute, 186, 215, 228
Visitors to the U.K., 36, 205, 280

Water Pollution Research, International Conference on, 422
Water Treatment and Examination, Society for, *see* Society for Water Treatment and Examination
Waverley Gold Medal Essay Competition, 204
Webb, K. R., 'Sir William Robert Grove (1811-1896) and the Origins of the Fuel Cell,' 291
'Smithson Tennant, 1761–1815,' 432
Welsh College of Advanced Technology, 266
Western India Secion, 34, 151, 248, 285, 381
Women Science Teachers, Association of, *see* Association of Women Science Teachers
Women Teachers, Refresher Course for, 300
Worshipful Company of Horners Award, 420
Wyatt, P. A. H., *see* Leisten, J. A.

Yorkshire Council for Further Education, 183